Long-Term Economically Efficient Transmission Systems in a Restructured and Deregulated Electric Power Industry

by

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ABSTRACT

The $200 billion American electric power industry is in the early stages of its most significant restructuring since the beginning of the century. Deregulation of the industry's generation segment is the focus of most attention at present, but restructuring will have profound implications for all aspects of the industry -- including transmission, the industry's "integrating" segment. Using criteria grounded in economic principles and research, and lessons learned from the deregulation of other industries, we evaluate five leading restructuring proposals based upon their predicted impact on the long-term economic efficiency of transmission. We find that none of the proposals fully addresses all of the issues identified by our criteria or consider technological innovation in transmission. Furthermore, only some of the proposals would explicitly employ transmission pricing mechanisms that are consistent with efficient economic principles. While most of the debate to date has focused on selecting the "best" framework for restructuring, we find that the details of the restructuring proposals have an equally large, if not larger impact on long-term economic efficiency in transmission. A policy implication of this is that the public should continue to play an integral role in the decision-making process as the debate moves from broad framework issues to more mundane proposal details. With respect to the specific proposals we evaluate, we find that the FERC Mega-NOPR is deficient in several areas. We also find that the California Public Utilities Commission appears to have chosen the "best" of the three alternatives it considered, at least according to our criteria.

We also examine the prospects for non-utility transmission systems (NUTS). We find that complete NUTS (which would be independent and competitive with existing systems) are not economically viable in the short-term, nor would they be in the long-term without revolutionary technological advances. Nevertheless, there are definite possibilities for competitive provision of some transmission functions in the short-term. Non-utility firms (partial Nutcos) should develop as new entrants are allowed into these niches. In the long-term, these firms could propel further deregulation of transmission functions through the evolutionary process of technology and policy advances. Provisions in contemporary restructuring proposals that could serve as "headwaters" for later transmission deregulation include: competitive solicitation of ancillary services to the greatest extent allowed by technology, the creation of secondary markets for transmission service, transfer of system control from utilities to independent system operators (ISOs), and market-based processes for new transmission line construction and ownership. Other policy mechanisms, such as favorable treatment for firms that use new technologies to supply transmission services, could be used to stimulate technological innovation. By carefully considering the consequences in advance, those who design today's deregulation proposals can lay the groundwork for another radical and beneficial restructuring in the future.

Thesis Supervisor	Richard Keith Lester
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Dedication

Freedom -- consists not in doing what we like, but in having the right to do what we ought.[1]

-- Pope John Paul II (1995)

Just as an electron may assume that it moves independently of all other particles in its minute, yet vastly empty universe, it is appealing to believe that we too are independent of all those around us, and that the path of our life is totally determined by our own work and merits. Such a view is sadly naive, however. Like an electron's path that is shaped by interactions with other atomic particles, our lives are the integration of the interactions we have with others and the resources they bring to us, made possible by our God-given talents, and catalyzed by our personal efforts and decisions.

It is very easy for those of us who are blessed to be at a place like MIT to forget the special opportunity that we have. With that in mind, and realizing that one does not receive the privilege of being an MIT student totally of his own accord, I'd like to dedicate this thesis to those who helped make it possible to write it in the first place and who have helped to make me who I am:

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And finally, and most importantly, I'd like to dedicate this to the Lord, who has blessed me with my life, my talents, and the opportunity to be a part of the remarkable learning community at MIT; and in Whose image all of the people above were created.

[1]Cited in: "Pope Ends Tour, Calling for Policies of Mercy."

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Acronym	Definition
AC	Alternating Current
AEP	American Electric Power Company
AGC	Automatic ceneration controller
ASC	Advanced series compensator
AT&T	American Telephone and Telegraph Company
CELCO	Cambridge Electric and Lighting Company
Con. Ed.	Consolidated Edison
CPUC	California Public Utilities Commission
CRT	Capacity reservation tarriff
CTC	Competitive transition charge
DC	Direct Current
DOE	Department of Energy
DPU	Department of Public Utilities
DSM	Demand-side management
EBB	Electronic Bulletin Board
ECC	Energy control center
EDC	Electric Distribution Company
EEI	Edison Electric Institute
EIA	Energy Information Administration
EIS	Environmental impact statement
EMF	Electric and magnetic fields
EPAct	Energy Policy Act of 1992
EPRI	Electric Power Research Institute
EWG	Exempt Wholesale Generator
FAA	Federal Aviation Administration
FACTS	Flexible alternating current transmission systems
Fedex	Federal Express
FERC	Federal Energy Regulatory Commission
FCC	Federal Communications Commission
FPA	Federal Power Act
FPC	Federal Power Commission (replaced by FERC in 1977)
GTO	Gate turn-off thyristor

INGAA	Interstate Natural Gas Association of America
ISO	Independent system operator
IT	Information Technology
LDC	Local distribution company
LILCO	Long Island Lighting Company
MCI	Microwave Communications Inc.
MCT	MOS-controlled thyristor
Mega-NOPR	A Large Notice of Proposed Rulemaking
MFJ	Modified Final Judgment of the 1956 Consent Decree (the MFJ was signed in 1982)
MIT	Massachusetts Institute of Technology
MOU	Memorandum of Understanding
NARUC	National Association of Regulatory Utility Commissioners
NEES	New England Electric System
NELA	National Electric Light Association
NEPOOL	New England Power Pool
NERC	North American Electric Reliability Council
NGA	National Gas Act of 1938
NGPA	National Gas Policy Act of 1978
NMSU	Northeast Missouri State University
NOPR	Notice of Proposed Rulemaking
NPPC	Northeast Power Coordinating Council
NSP	Northern States Power
NUG	Non-utility generator
Nutco	A non-utility transmission company
O&M	Operations and Maintenance
OASIS	Open access same-time information system
ORNL	Oak Ridge National Laboratory
OTA	Office of Technology Assessment (or Office now Totally Abolished)
PBR	Performance based regulation
PCA	Protective coupling arrangement
PG&E	Pacific Gas and Electric
PIFUA	Powerplant and Industrial Fuel Use Act of 1978
PL	Public Law
PMA	Power Marketing Adminstration
POD	Point of delivery

POOLCO	A proposal for a pool-based electric power system
Poolco	The operator of a pool-based system
POR	Point of receipt
POTS	Plain old telephone service
PSC	Public Service Commission
PUC	Public Utilities Commission
PUHCA	Public Utility Holding Companies Act of 1935
PURPA	Public Utility Regulatory Policies Act of 1978
PX	Power Exchange
RBOC	Regional Bell operating company
RCR	Regional competitiveness ratio
REC	Rural Electric Cooperatives
RINs	Real-time information networks
ROR	Rate-of-return
RTP	Real time pricing
SCE	Southern California Edison
SCR	Silicon-controlled rectifier
SDG&E	San Diego Gas and Electric
SEC	Securities and Exchange Commission
SI	Stranded investment
T&D	Transmission and Distribution
TCC	Transmission congestion contract
TO	Transmission owner
TQM	Total quality management
TURN	Toward Utility Rate Normalization
TVA	Tennessee Valley Authority
UDC	Utility distribution company
UPS	United Parcel Service
VAR	Volt-Ampere reactive power
WEPEX	Western Power Exchange
WPT	Wireless Power Transmission
WSCC	Western System Coordinating Council

PART I:

SETTING THE CONTEXT

Chapter 1
Introduction

The electrical utility industry as we have known it -- especially in the past 15 years -- has been like ancient Rome. It was a bastion of civilization compared to the brawling, deregulated world around it. It was an industry that was stable, profitable, and predictable. It delivered electricity efficiently and economically to any and all customers. As in ancient Rome, the barbarians are at the gate. And our glorious civilization will never be the same. It need not be worse either.[1]

-- John J. Barry (1994)

1.1 DEREGULATION COMES TO ELECTRIC POWER

1.1.1 Deregulation in the American Economy

The American economy has experienced a series of extraordinary changes during the past two decades as industries that were once guided by command-and-control regulatory structures have been opened to the free market. Starting with the airline industry in the late 1970s, numerous industries have undergone the liberating, yet wrenching process of deregulation. The continued experience has been that:[2]

- Total costs always fall, they never rise;
- Productivity always increases, it never declines;
- Customers as a group always wind up with more choices, not fewer;
- Technological advance and new products are always spurred, never retarded;
- Responsiveness to customers improves, it does not degrade; and
- We never wish to restore regulated monopoly where it has been superseded by genuine competition.

Now deregulation is beginning to encroach on the electric power industry, one of the last bastions of command-and-control regulation, and one of the nation's largest industries. If the experiences of other industries serve as a guide, electric power firms will soon experience "a period of abrupt upheaval, intense competition, and rapid repositioning."[3]

1.1.2 What Makes Electric Power Special

With so many precedents in regulatory reform, it could be assumed that electric power deregulation will be relatively straightforward and will follow a steady and predictable course. Although the industry should benefit from the deregulation experiences of other

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[1] Barry, 1994, 47.
[2] This list is quoted from: Bradford, 1994, 8.
[3] Gardner and Gilson, 1994, 24.

industries,[4] it could also suffer from them. Noting that much of the discussion regarding deregulation lacked a fundamental understanding of electric power technologies and systems, Paul Joskow and Richard Schmalensee once commented, "Sound policy cannot be made on the basis of casual analogies [to other industries, most notably airlines]. Airlines and electric utilities differ in fundamental ways that are central to the workings of competition under deregulation."[5] At least three sets of characteristics differentiate the electric power industry from its deregulated predecessors.

1.1.2.1 Technical Reasons

Electric power systems are technically more complex than other deregulated production systems. Paul Joskow comments,

> An electric power system is an integrated physical network that operates as one large machine, not a set of independent straws through which electrons flow. While the laws of supply and demand and the invisible hand are very powerful, they are not more powerful than the laws of physics and can operate efficiently only by accommodating physical realities.[6]

The physical laws that govern electric power flow lead to non-intuitive physical constraints on the planning, operation, and economics of power systems.[7] For example, electricity cannot be stored (except at prohibitively high cost); and it must be moved over closely-coordinated, integrated systems that display large economies of scale.[8] Furthermore, a consequence of the interconnected nature of power systems is that competitors in a deregulated industry structure would be intimately related to each other. This situation would create significant opportunities and incentives for physical and economic externalities. While the telephone and natural gas industries are often considered to be analogs of the electric power industry, fundamental system operation differences exist between them. For example, it is possible to store and direct the flow of natural gas (neither of which can be done currently in an electric power system). Telephone systems are designed to "switch" calls from a sender to his designated receiver. Furthermore, a telephone system overload leads to busy signals for some callers, while an overloaded electric power system could collapse. Restructuring implications and constraints arise from these technical differences.

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[4]For example, the take-or-pay issue in the natural gas industry -- its version of "stranded investments."

[5]Joskow and Schmalensee, 1983, 8. While this quote was made in reference to the debate in 1983, when talk of electric power deregulation was in its incipient stage, it is unfortunately still relevant to the current situation.

[6]Joskow, January-February 1996, 69.

[7]Kahn and Baldick, 1994, 191.

[8]Ruff, 1994, 25.

1.1.2.2 Structural Reasons

Joskow and Schmalensee identify electric power system structural characteristics, some of which are significantly different from those of other deregulated industries. Electric power systems are:[9]

- Largely composed of immobile capital;
- Complex systems in general;
- Providers of a service which faced low demand growth;
- Financed through complex financing arrangements;
- Dominated by generating stations which still have long useful lives;[10]
- Operated by a mix of private and public power agencies; and
- Subject to complex state and federal regulations.

When combined together, these structural characteristics make electric power industry restructuring a particularly challenging undertaking.

1.1.2.3 Economic Impact Reasons

The industry is also "special" because of its large economic impact.

1.1.2.3.1 Industry size

The electric power industry is the most capital intensive part of the nation's infrastructure[11] (investor-owned utilities alone have $580 billion in utility plant assets),[12] and it is one of the nation's largest industries in terms of employees (406,000)[13] and revenues ($202.7 billion).[14] In comparison with its deregulatory analogs, the electric power industry's annual revenues are greater than those of the long-distance telephone, domestic airline and natural gas industries, *combined.*[15]

1.1.2.3.2 The "Sun" of industry

Electricity is arguably the most fundamental input into the functioning of advanced societies in the late twentieth century. As Schurr *et al* note, "In a remarkable profusion of applications, electricity has penetrated deeply and brought important changes into virtually every corner of American life."[16] We live in an age where electronics, and the information technologies that are built upon them, are becoming the driving forces of our modern

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[9] Joskow and Schmalensee, 1983, 9.
[10] The current system is dominated by plants built in the 1970s and early 1980s. Source: Gillenwater, 1996, Chapter 4.
[11] Source: "Vantage Point."
[12] Edison Electric Institute, *Statistical Yearbook of the Electric Utility Industry 1994*, 85.
[13] Bureau of Labor Statistics, 1995, 96.
[14] Energy Information Administration, November 1995b, 5.
[15] Energy Information Administration, November 1995b; and Standard and Poors.
[16] Schurr *et al*, 1990, xiii.

economy. The Japanese have described semiconductors as being the "rice" of 21st century industries. To extend the metaphor, electricity could be described as the "sun" of industry -- the energy source that powers semiconductors and most other high value-added industries of today and tomorrow. Electricity also plays an important, often increasing role in traditional industries. For example, the steel industry is undergoing significant change as the result of electric arc furnaces. Indicative of this is the fraction of raw steel melted electrically, which grew from 10 percent in 1965 to 35 to 40 percent today.[17]

Because of these factors which make the electric power industry "special," it is important that careful analysis, grounded in an understanding of the industry's technologies, be incorporated into restructuring decisions.

1.2 CHANGING OBJECTIVES

The industry has traditionally been a classic example of a stable industry -- its structures, players, and fundamental objectives have stayed constant or have been only marginally modified over multiple decades. For example, during the 1970s and 1980s there were five broad operating objectives for electric power systems:[18] satisfaction of consumer demand, system security, cost minimization, fuel conservation, and minimization of environmental impacts. While often conflicting, these were a well-defined and generally accepted set. But the emergence of competition in the industry has turned this list on its head. Those attempting to restructure the industry have proposed widely varying sets of objectives for the industry's new competitive era.[19] For example, the Wisconsin Public Service Commission formulated three objectives for the restructuring process,[20] while the Massachusetts Electric Industry Restructuring Roundtable developed eighteen.[21] Thus, as the industry moves from one era to another, its most fundamental assumptions, let alone the details of how the industry should be constituted, are points of contention.

1.3 ISSUES IN THE CURRENT DEBATE

While industry restructuring raises many issues, two come to the fore in most deregulation debates.

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[17]Gellings, 1994, 35. This is one of the major reasons that the energy intensity of steel production has dropped 40% since 1960. Source: Ibid., 40-41.

[18]Fink, 1983, 162-164.

[19]See Appendix A for a listing of restructuring principles that have been advanced by regulatory bodies and advocacy groups across the country.

[20]Wisconsin Public Service Commission, July 1995, 3.

[21]Electric Industry Restructuring Roundtable, 1995.

1.3.1 Stranded Investments

Probably the most divisive issue is determining how to handle stranded investments (SIs).[22] These "unused and useless"[23] investments include[24] "uneconomic" generating plants, "uneconomic" power purchase contracts, regulatory assets, and public policy programs. The SI issue is of particular importance to the nuclear power sector. While not the only source of SI, uneconomic nuclear power plants are the largest contributors to it.

Utilities generally assert that they deserve full compensation for their SIs based upon a fundamental agreement between state commissions and utilities, commonly termed the "regulatory compact." In contrast, large industrial users and those who wish to enter the generation market counter that these assets should be considered economic "sunk costs." They further assert that any attempt to ameliorate these losses would produce pricing inefficiencies and market distortions. Due to the tens or hundreds of billions of dollars at stake, the debate over stranded investments debate is intense, and the parties will not easily reach a compromise.

1.3.2 The Transmission Network and Open Access

The other focus of debate is the transmission network, which serves as the backbone of modern electric power systems. Essentially all power that is produced for sale passes through transmission systems. Electric utilities have traditionally built, owned, and operated the transmission facilities located within their service area. Consequently, grid ownership is highly fragmented -- there are approximately 166 investor-owned utilities (IOUs) with transmission assets regulated by the Federal Energy Regulatory Commission (FERC),[25] and numerous other regulation-exempt, transmission-owning public power agencies.

The source of debate stems from the market power that vertically-integrated utilities would have in a competitive generation market. Under the existing industry structure, utilities would have financial incentives to prevent "competitive" power from being wheeled[26] over

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[22]For a more comprehensive discussion of the stranded investments issue, see Appendix B.7.6.
[23]Michaels, 1994.
[24]The exact definition of stranded investments is a point of contention. For varying definitions, see: Hirst and Baxter, 1995; Pierce, 1994; and Michaels, 1994.
[25]Source: "Electric Utilities to Provide Access for Competitors," D4.
[26]Electric power is wheeled when the transmission lines of one or more utilities are used to transport electric power from a seller to a buyer. Source: Kelly *et al*, 1987, iii.

their transmission lines.[27] Since transmission is a currently a monopoly function (and many analysts believe that it is a natural monopoly),[28] vertical market power could allow utilities an unfair advantage through their control of "bottleneck" transmission facilities.

The proposed remedy is to require that utilities offer transmission service to all users on an equal basis (known as "open access"). Proponents advocate that open access would eliminate the vertical market power of transmission-owning utilities, thereby facilitating the development of an efficient generation market. However, those utilities that fear for their future in a deregulated industry are reluctant to have these strategic assets converted to "common carrier" status, since their control of the transmission system is their leverage in restructuring debates and negotiations.

1.3.3 Moving Beyond Transition Issues

The focus on stranded investment and the portrayal of transmission as a "bottleneck" to keep open, rather than as a valuable resource, are symptomatic of a debate that has the lowering of near-term electricity rates at its heart. For example, in introducing its pioneering proposed rulemaking on electric power industry deregulation, the California Public Utilities Commission (CPUC) explicitly stated, "we are single-minded in its [the rulemaking's] objective -- to lower the cost of electric service to California's residential and business consumers without sacrificing the utility's financial integrity."[29] With such a perspective driving the process, it is not surprising that much of the debate has focused upon transitional and short-term issues. However, this thesis argues that this near-term focus is mistaken and we seek to look beyond the near-term.

1.4 The Importance of the Long-Term Perspective

While transition issues are daunting and require careful study, they should be handled in the context of a longer-term outlook. As Paul Joskow comments, "[In the year 2005] no one will remember what a stranded cost is."[30] Nevertheless, it is difficult to take a long-term view when some industry participants face significant near-term issues. For example,

[27] A less important, but non-trivial incentive for blocking wheeling is that increased line losses accompany increased power flows. Approximately 3% of power is dissipated due to the resistance of transmission lines and reactive power. Line losses increase as lines become more heavily loaded. There is no generally agreed upon method for compensating for these losses, as a result, transmission utilities are forced to bear them.

[28] And as such, requires regulation. For instance, see: Hyman, 1994, 134.

[29] CPUC, 20 April 1994, 1. The analogous order by the Massachusetts Department of Public Utilities featured a similar comment. See: Massachusetts Department of Public Utilities, 16 August 1995, 1.

[30] Joskow, January-February 1996, 67.

some utilities have stranded investments greater than their stockholder equity[31] and some industrial customers are trying to cut costs in order to stay in business. Nevertheless, taking the long-term view is important for the well-being of society and of the industry's firms. As Richard Pierce notes:

> Utilities also need to resist the tendency to become so preoccupied with minimizing transition costs that they neglect the process of devising a new legal regime that is capable of producing an efficient and reliable post-transition electricity market. While the FERC must take the lead in that process, the task is so difficult and multi-faceted that the FERC cannot hope to be successful without the active assistance of utilities. The FERC desperately needs help in crafting regulatory rules that will produce healthy incentives for socially beneficial patterns of investment and transactions, and in nurturing the new institutions and ways of doing business that are critical to creation of an efficient and reliable post-transition electricity market. The electric utility community cannot allow the bitter conflicts among market participants that will occur throughout the transition process to mask the reality that all market participants share an interest in creating a new legal environment that will allow the electricity market to function efficiently once the transition is complete.[32]

The desirability of creating the efficient legal environment mentioned above is just one of several reasons that the public policy process of restructuring the electric power industry should focus on the long-term.

Another reason for having a long-term focus is that pricing structures developed for short-term issues can cause economic distortions in capital expenditures. Meyer and Tye conclude from their study of deregulation transition pricing in the transportation and telecommunications industries that:

> Substantial departures from prices based upon long-run cost considerations, even though sometimes bestowing short-run benefits, have a good deal of potential for achieving misallocation of resources and other economic mischief in the long-run.[33]

Since many electric power assets (including transmission capital investments) are immobile and long-lived, "improper" capital investment decisions caused by price distortions would have decades-long consequences.[34]

The desirability of technological development is yet another reason for having a long-term focus. Economic research has found that the path of technological development is not predetermined -- breakthroughs are a function of an industry's market structure and prior

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[31]For instance, see: Baxter and Hirst, 1995.

[32]Pierce, 1994, 349-350.

[33]Meyer and Tye, 1985, 49.

[34]Due to depreciation cycles, this issue is larger than electric power than in some other industries. For example, in the semiconductor industry, massive capital investments are made on production facilities that are used (and paid for) on the order of several years. Source: Lohr, 1995, 14.

breakthroughs.[35] Technological adoption and development choices are influenced, if not driven, by market incentives and explicit public policy decisions. As a result, future efficiency improvements could be sacrificed if attention is focused on near-term issues and contemporary technologies, rather than on incentives for technological development and long-run efficiency.

Finally, responsible policy-making dictates a concern for the long-term. In order for societies and firms[36] to sustain themselves, they must look ahead and make provisions for the long-run. Consequently, new institutional arrangements not only must function and provide efficiency gains in the near-term, but must also provide for a sustainable system over the long-term. Historically, the American electric power industry has been generally successful at providing reliable power at a price in line with other developed nations.[37] A long-term perspective should help ensure that this high technical performance continues as new ownership and economic structures emerge from the restructuring process.

1.5 THE TRANSITION IN PERSPECTIVE

While we advocate that a long-term perspective is important, we also recognize that a transition period that includes the resolution of significant issues must nevertheless be traversed before a dynamic equilibrium, with its anticipated increased efficiencies, can be reached. The industry has arrived at its current state as a result of a century-long evolutionary process. It is naive to believe that it can be completely reconstituted overnight in an efficient manner. Any attempt to do so would run counter to the incremental nature of American policy-making, would ignore the constraints and commitments -- both implicit and explicit -- of the former system, and would assume knowledge of the future that does not exist.

Neither the length of the transition period, nor the work that must occur during it, are trivial. Other industries, such as natural gas and telecommunications, have now been moving through their transition periods for more than a decade. Evidence from practice and theory indicates that the movement to a new industry structure is not deterministic -- dynamic efficiency could be reached in many different states, and at many different levels of efficiency. As a result, the decisions that are made regarding how to handle transition

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[35]See, for example: Arthur, 1989.
[36]For example, the MIT Commission on Industrial Productivity's findings illustrate the disastrous consequences that can occur when firms become too focused on short-term performance. See: Dertouzos *et al*, 1989, 53-66.
[37]Kahn, 1996, 47; and Smith, 1996.

issues impact the current players and their short-term interests as well as the industry's long-term efficiency. These transition debates also occur in the presence of great uncertainties about the future -- ranging from political issues to technological innovation. Because of these factors and the iterative nature of policy-making, we should not expect that decisions made today will be the "correct" and final ones. Rather, policies should be designed such that they *lead* the market *toward* greater long-run efficiency (rather than attempt to get there in one bold move). However, they should focus on achieving a more efficient future, rather than benefits in the short-term.

The focus on short-term issues, such as opening the competitive bottleneck from transmission systems, has brought with it another unfortunate result -- precious little attention is being paid to the future development of transmission systems.

1.6 THE IMPORTANCE OF EXAMINING TRANSMISSION

Electric power transmission networks are technically and economically highly complex systems. Consequently, their efficient operation in a restructured industry will not happen by chance -- it will occur as a result of careful deliberation during the restructuring process.

The technical complexity of transmission systems stems from their function of moving enormous amounts of power over a wide area, constrained by the necessity of instantaneously[38] balancing load and generation, while preserving a stable power frequency and voltage. Due to the many pieces of power generating and consuming equipment that interact with transmission systems at any given moment, operating within these constraints is especially difficult.

The economic complexity of transmission systems is related to their inherent externalities as well as their high capital costs and low marginal costs. The intimate physical relationships between the power flows of the grid's users create many opportunities for externalities, which have implications for transmission pricing structures. The high fixed costs of transmission assets also pose a challenge because, as noted by MIT economist Peter Temin, "there is no uniquely correct way to allocate fixed costs to units of production."[39] Consequently, although transmission pricing mechanisms are partly arbitrary, they must be designed to allocate capital costs in a manner which provides appropriate incentives for system use and prevents or minimizes externalities. Pricing schemes must also provide

[38]i.e. on a scale of 1/60 of a second and or less.
[39]Temin, 1994, 11.

sufficient revenues and appropriate incentives for capital improvements and maintenance. Furthermore, it is important to consider incentives for technological development when designing transmission pricing mechanisms. With trillions of kWh and billions of dollars crossing transmission systems every year, even small technical performance improvements would have significant financial benefits.

1.7 THESIS OBJECTIVES

1.7.1 Assumption of Increased Competition

The momentum for deregulating the industry is great, and the experiences of other industries indicate that once unleashed, deregulatory forces are nearly impossible to contain. As Alfred Kahn noted recently, "once you begin to admit competition, it introduces strains and distortions that can typically be resolved only by further deregulation."[40] Given the forces within the industry and in society at large, this thesis operates under the assumption that the deregulation process will continue.

1.7.2 The Thesis Topic

This thesis evaluates the long-term implications for transmission systems of current restructuring decisions. The basic approach is to evaluate five industry restructuring proposals based upon their predicted impact on the long-term economic efficiency of transmission systems. While we examine specific proposals, we also attempt to gain insights on the relative merits of several restructuring frameworks (i.e. pool-based, bilateral, etc.). The thesis also explores the prospect of deregulating the transmission system itself, of parts thereof. Specifically, we explore whether it is realistic to contemplate the emergence of non-utility transmission systems (NUTS). In our analysis we consider two types of NUTS -- complete NUTS, which would be complete, competing transmission systems; and partial NUTS, which would mean that some of the transmission services on a common transmission system are provided competitively.

In order to carry out our analysis, we develop economic efficiency criteria that are based on economic research and principles, and on lessons learned in previous deregulation experiences. We strive to perform this analysis with a grounding in the technical details and historical context of the electric power industry.

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[40] Kahn, October 1994, 27.

1.7.3 The Thesis as Technology and Policy

At its core, this thesis deals with both technology and policy issues. Electric power industry restructuring is a policy debate with many fascinating aspects. While deregulation is being forwarded because it is expected to provide net benefits to society, it will also result in large, direct transfers of wealth. With billions of dollars at stake, there will be clear winners and losers.[41] As a result, strong interests are being brought to bear on the political process as it goes through the complicated task of reconstituting the industry. In addition to its financial ramifications, the debate's outcome has significant implications for the relationship between the government and the private sector.

However, these political processes must be bounded by the constraints of the industry's physical and financial "technologies." The challenge in creating an efficient industry structure is to make appropriate connections between two "parallel universes": the technical operation of electric power systems and the industry's financial workings. While the technical and financial "universes" function separately, they cannot function independently. Decisions in one have implications in the other. In a deregulated industry, the physical flows of electricity and the financial flows of money could be very different, but they must be reconciled in a manner that signals the efficient use of physical and financial resources in the short- and long-run. A further complication is that the physical universe is constrained by existing massive infrastructures which must obey the laws of physics. These infrastructures have traditionally been operated in a technically laudable manner. Consequently, a restructuring objective should be to reconstitute the industry's financial structures while maintaining (or making few changes to) its enviable physical operation. The thesis seeks to bring this technical perspective to the debate in full recognition that the ultimate decisions about industry restructuring will be made through political processes, where compromise, political entrepreneurship, and power are often of greater importance than technical accuracy.

1.7.4 Relevance to Nuclear Engineering

This thesis is also relevant to nuclear engineering because restructuring will have an important impact on the future of the nuclear industry. The manner by which prices are set and the network is configured could determine whether currently operating nuclear plants will face "early" shutdown. The potential for future plants will also be affected by deregulation.[42] If the public would once again accept the use of nuclear technology for

[41] Vamos, 1995, 24.
[42] For instance, see: "Deregulating the U.S. Electric Industry."

electricity generation, the economics of the grid and the larger industry would determine whether investors would be willing to build and operate them.

1.8 THESIS OUTLINE

The thesis is divided into three parts: setting the context, establishing evaluation criteria, and analysis.

1.8.1 Part I: Setting the Context

The next four chapters lay the groundwork for the current debate. **Chapter 2** describes the basic technical characteristics of the industry, with a particular emphasis on transmission.

Chapter 3 summarizes the industry's history, focusing on events that are crucial for understanding today's restructuring. The chapter also discusses the industry's current status and offers some thoughts on its future. This chapter is augmented by a fuller discussion of the industry's history, which occurs in Appendix B.

Chapter 4 examines how utilities have made internal changes in recent years to better prepare for the coming competitive era.

Chapter 5 discusses various electric power industry deregulation processes and proposals. It begins with a brief survey of the electric power deregulation experiences in other countries. The chapter then explores the deregulation debate in California, the state leading the deregulation process in the U.S., and outlines several proposals which have been considered there. Developments and proposals in several other states that are actively pursuing deregulation are next discussed. The chapter also examines the March 1995 Federal Energy Regulatory Commission proposed rulemaking that is intended to facilitate non-discriminatory open access to transmission systems. The chapter concludes by listing the five proposals that are evaluated later in the thesis.

1.8.2 Part II: Establishing Evaluation Criteria

Criteria for evaluating the restructuring proposals are developed in the four chapters in this part of the thesis. **Chapter 6** examines the process of deregulation in two industries that are often used as templates for electric power deregulation discussions: natural gas and long-distance telephone service. These cases are reviewed in order to gain insights on long-run economic efficiency implications.

Chapter 7 examines three transmission technologies that are currently under development, and their potential impact on electric power systems in the future.

Chapter 8 employs criteria based upon competitive strategy frameworks to explore the question, "would divestment be economically efficient?"

Chapter 9 draws upon the previous chapters as well as economic principles and research, to develop criteria by which the deregulation proposals are evaluated for their impact on long-run economic efficiency in transmission.

1.8.3 Part III: Analysis

The final part of the thesis is devoted to analysis. **Chapter 10** evaluates the five restructuring proposals against the economic efficiency criteria developed in Chapter 9.

Chapter 11 probes the concept of non-utility transmission systems (NUTS). The chapter identifies potential benefits, drawbacks, and impediments to their development. It also explores the likely impact of current deregulation proposals on the development of NUTS, outlines potential pathways for their development, and mentions potential NUTS developers.

Chapter 12 presents the thesis's conclusions.

The **Afterword** provides a brief commentary on two major industry events which are particularly relevant to this thesis, but which occurred as final revisions were being made.

Chapter 2
What Is Transmission and Why Is It Important?

The role of the transmission network in transporting power and in coordinating the efficient supply of electricity in both the short run and long run is the heart of a modern electric power system. The transmission system is not just a transportation network that moves electricity from individual generating plants to load centers. Transmission plays the most fundamental role in achieving the economies of electric power supply that modern technology make possible. The practice of ignoring the critical functions played by the transmission system in many discussions of deregulation almost certainly leads to incorrect conclusions about the optimal structure of an electric power system.[1]

-- Paul L. Joskow and Richard Schmalensee (1983)

2.1 INTRODUCTION

Viewed in some ways, electricity is the consummate commodity -- the delivery of electrons, one of the fundamental particles in all matter. In comparison, even potatoes seem complicated, for while there are russets, Idahos, and California whites, there is only one kind of electron (with respect to electric power delivery). But this perspective on electric power production and delivery is over-simplified. While the production of potatoes occurs through a series of somewhat connected, yet discrete steps, there is an intimate interconnection between the production, physical delivery, and use of electrons in an electric power system. As a result, although electric power provision exhibits some of the economic characteristics of commodities -- product standardization and the ability to quantify the product -- the intimate relationship between production and use makes electricity a special product. In order to explain this, analogies to other systems, such as natural gas or telephone service, are made. However, despite the many similarities to telecommunications and natural gas systems, electric power systems have important, unique technological characteristics, such the inability to "switch" or "gate" power flows and the necessity of instantaneously balancing generation and load (electricity demand).

The intent of this chapter is to provide a basic introduction to the technology and economics of electric power production. We briefly examine each of the three major components of an

[1]Joskow and Schmalensee, 1983, 63.

electric power system: generation, distribution, and transmission. Through our discussion we hope to provide the reader with an answer to the question, what is transmission and why is it important? We begin our discussion with the industry segment that is largest in terms of costs, and which is receiving most attention in the deregulation debates.

2.2 GENERATION

Electric power generation is the process by which electrons become excited, thus creating electric energy. The most common type of generating stations are thermal-steam plants. In these plants, water is heated into steam, which passes through a turbine, which in turn propels a generator. The generator is a coil of wire that turns on a rotor in the midst of a magnetic field.[2] In the United States, the most common fuel source for heating the water is coal, with uranium (in nuclear plants) coming a distant second (in terms of power generated).

Table 2.1: U.S. Electric Power Capacity and Generation, By Fuel Source and Prime-Mover (1994)

Fuel Source	Capacity (MW)	Net Generation (Million kWh)
Fossil Steam	**445,296**	**2,001,561**
Coal-Fired	301,098	1,635,493
Petroleum-Fired	41,151	86,469
Gas-Fired	103,047	259,554
Nuclear	**99,148**	**640,440**
Gas Turbine/Internal Combustion	**59,575**	**36,130**
Petroleum-Fired	28,768	4,570
Gas-Fired	30,807	31,560
Hydroelectric Pumped Storage	**21,168**	**-3,378**
Renewable		
Conventional Hydroelectric	75,196	247,071
Geothermal	1,747	6,941
Biomass	459	1,988

Source: Energy Information Administration, 1995b, 10, 22.

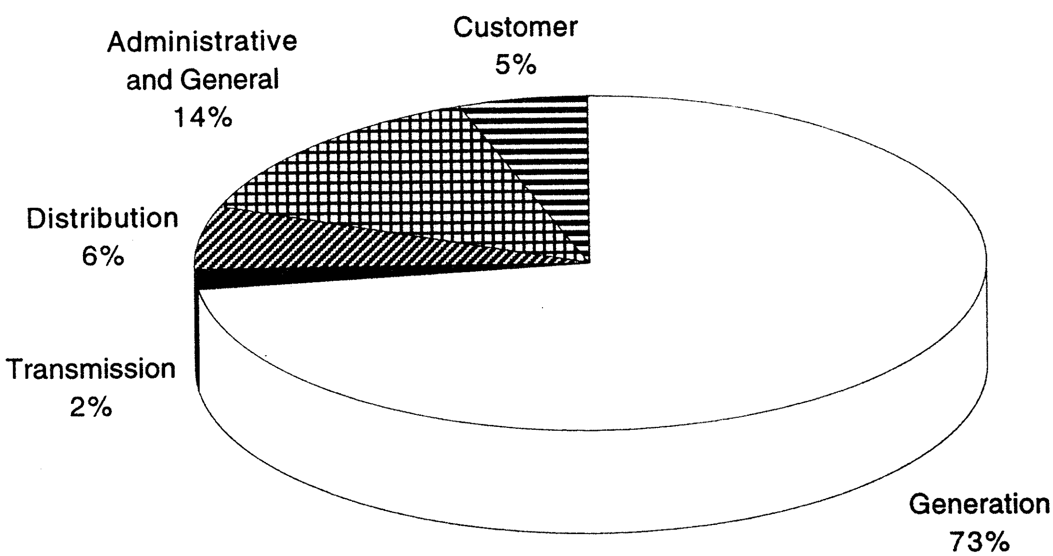
This thermal-steam process is based upon the Rankine cycle, and is a rather energy-inefficient process. The Rankine cycle's limit on energy conversion efficiency is about 40%,[3] which means that at least 60% of the energy input is "wasted." In recent years, cogeneration and combined-cycle power plants, which use this "waste heat" for productive purposes, have come into greater use.

[2]For more detail see: Graves, 1995, 2-15.
[3]Yeager, 1994. This is the theoretical limit. Most plants have efficiencies of 28%-35%.

The power produced in almost all American electric generators is three-phase alternating current (AC) power with a frequency of 60 hertz.

Generation is the largest expense in the electric power production and delivery process, accounting for approximately 57% of fixed costs, and 75% of operation and maintenance (O&M) costs.[4] (See Figures 2.1 and 2.2) Because of the large amount of money involved, relatively small efficiency improvements have large financial benefits. This is one of the factors that drives the push toward deregulating this segment of the industry.

Figure 2.1: Electric Power Production Expenses for Major U.S. Electric Utilities (1994)



Source: Energy Information Administration, December 1995.

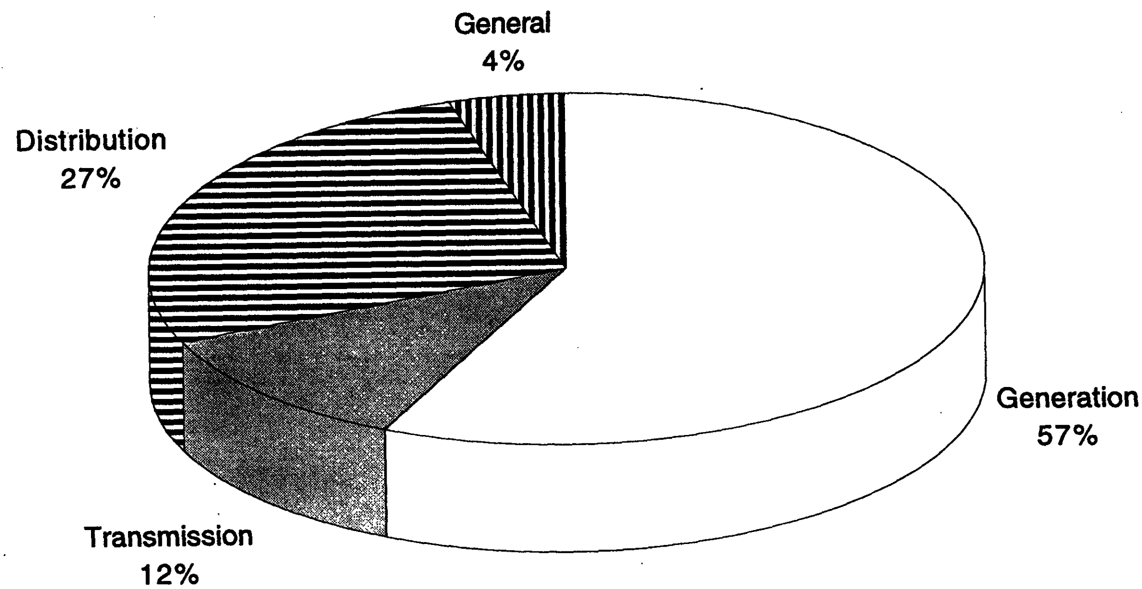
2.3 DISTRIBUTION

Distribution systems, which are at the other end of the power production and delivery process, receive electricity from transmission systems and deliver it to end users. In most cases, the power voltage is stepped down by transformers when it comes off a transmission system and is delivered to customers at relatively low voltages. Distribution

[4]Energy Information Administration, December 1993.

is a relatively capital-intensive process, accounting for 27% of total utility assets while only 6% of O&M expenses.[5] It is widely accepted that distribution's technical function ("the wires") is a natural monopoly.[6]

Figure 2.2: Utility Plant Value for Major U.S. Electric Utilities (1992)



Source: Energy Information Administration, December 1993, 46-47.

Distribution systems also aggregate their customers' loads and produce or procure sufficient power to meet them. For example, a vertically-integrated utility has a service territory and is responsible for meeting the power needs of its customers through power it produces itself.[7] Likewise, a distribution-only utility is responsible for procuring (rather than producing) a sufficient amount of power for its customers. In both cases, the aggregation function is a relatively passive activity -- projecting and summing demand. This could change drastically once the industry is restructured. Because of new ownership

[5]Energy Information Administration, December 1993. Note, the latter statistic is slightly skewed since it is for large, investor-owned utilities. These entities produce the power for a number of customers of other entities, such as municipal utilities and electric cooperatives. Thus, distribution likely accounts for a slightly greater share of the assets and costs in the total industry.

[6]In fact, the argument that it would be inefficient to have competing wires running down both sides of a street is an effective example when explaining the concept of a natural monopoly.

[7]Only in recent years have wholesale purchases made up a significant amount of vertically-integrated power sales.

structures, information technologies, and economic incentives, aggregation could become an active function and the necessity of bundling the "the wires" and aggregation functions of distribution could be eliminated. In fact, many analysts believe that this unbundling is possible and would be beneficial.[8] The argument for retail wheeling is predicated upon this belief. If unbundling occurs, the "wires" part of distribution would continue as a regulated natural monopoly function while the aggregation function -- energy services -- would be a separate, unregulated (or lightly regulated) activity.

2.4 TRANSMISSION

In between generators and distribution systems are transmission systems,[9] which integrate power supply and demand. While we speak of these as being separate, there is overlap between transmission and generation and transmission and distribution. In both cases, attempts are being made to define the boundaries between them more precisely, but to some extent (especially between generation and transmission) the interconnectedness of electric power systems makes the problem intractable.

2.4.1 General Discussion

Transmission systems are relatively insignificant in terms of their contribution to the cost of electricity -- representing approximately 2% of O&M expenses[10] and about 12% of capital assets.[11] As a result, many analysts neglect the importance of efficiency in transmission. However, because of the important role that transmission plays as an integrator of resources in electric power systems, the long-term economic efficiency of transmission systems is important.

2.4.2 Composition of Transmission Systems

An examination of the technical nature of transmission systems requires a discussion of their composition on several levels.

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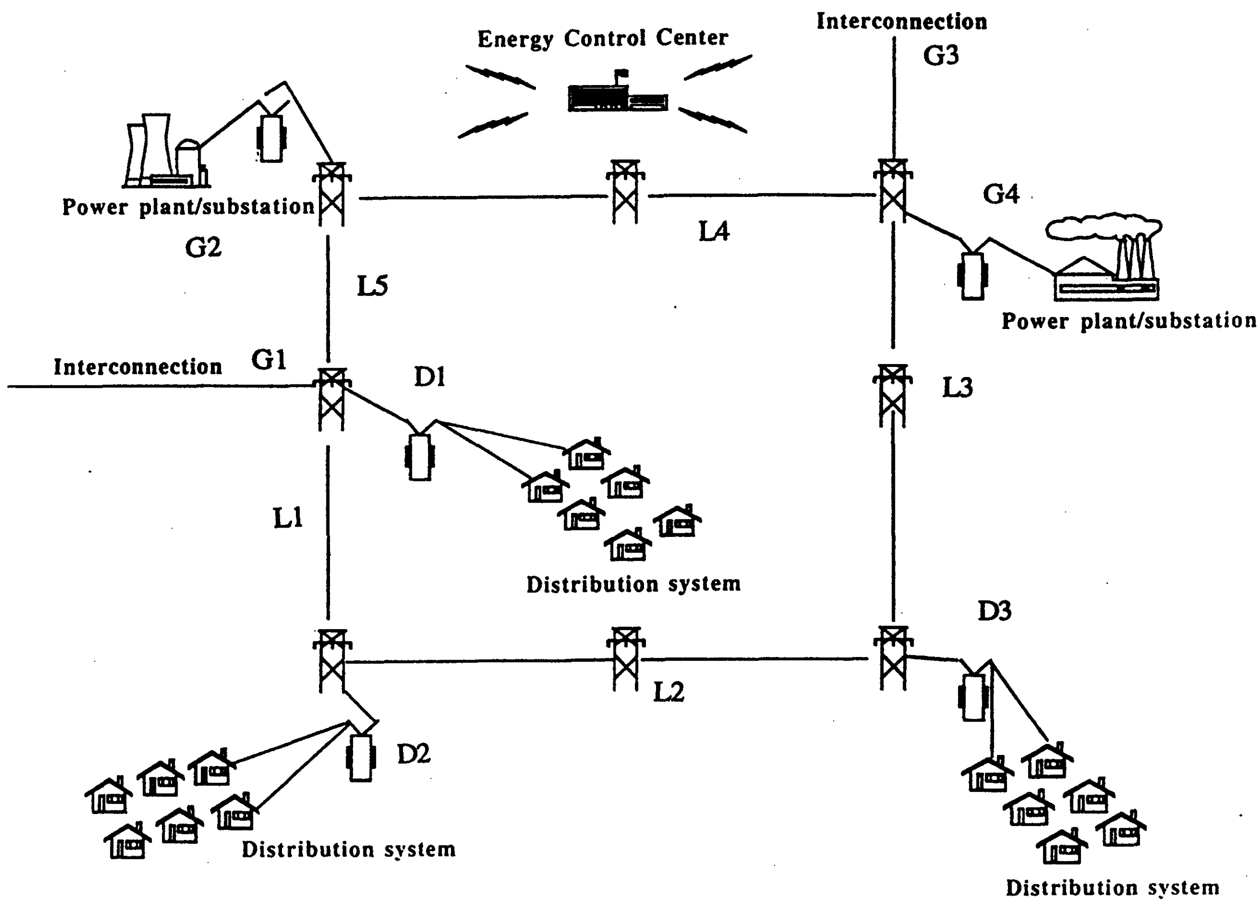
[8]For example, see: Knight, 1995; and Tabors, Caramanis and Associates, 1995.

[9]It should be noted that there is no clear or consensus division between transmission and distribution systems. In the Notice of Proposed Rulemaking on transmission open access (Mega-NOPR), the FERC attempted to do this, but was unable to draw a bright line. See: FERC, April 1995, 17711-17718.

[10]Energy Information Administration, December 1993, 31.

[11]Ibid., 46-47. The O&M cost figure is probably low by several percent, since some "transmission" functions, namely the provision of some ancillary services, are provided by generators and therefore the cost of their provision would be included in the generation O&M statistics.

Figure 2.3 Principal Physical Elements of Electric Power Systems



Source: Adapted from Wisconsin Public Service Commission, October 1995, 37

2.4.2.1 Control Areas

According to the most recent definition of the Institute for Electric and Electronic engineers, a control area is,

> an electric power system or combination of electric power systems to which a common automatic generation control scheme is applied in order to: 1. match, at all time, the power output of the generators within the electric power system(s) and capacity and energy purchased from entities outside the electric power system(s), with the load within the electric power system(s); 2. maintain, within the limits of good utility practice, scheduled interchange with other control areas; 3. maintain the frequency of the electric power system(s) within reasonable limits in accordance with good utility practice; and 4. provide

sufficient generating capacity to maintain operating reserves in accordance with good utility practice.[12]

Each control area has at least one energy control center (ECC) from which system dispatch occurs. A control area can consist of the complete or partial assets of one utility or can encompass those of a group of utilities.[13] There are approximately 140 control areas in the United States.[14]

2.4.2.2 Transmission System Functional Components

Continuing the atomic structure analogy, we identify three transmission "sub-atomic particles:" transmission lines, ancillary services, and system control.[15] For this thesis, we here define the transmission system to be composed of these three functions and all of the operations included in them -- even those provided by generators (i.e. several of the ancillary services).

2.4.2.2.1 Transmission lines

When one thinks of transmission systems, what probably first comes to mind are the large towers and long lines that cross the countryside. In 1995, there were 150,826 circuit miles of 230 kV and above transmission lines in the continental United States[16] and this number is expected to grow to 159,677 by the year 2004.[17] At least three conductors (at least one for each phase of power)[18] are used for each circuit. The conductors are most frequently made of dozens of strands of aluminum wire wrapped around a steel core.[19] These are attached to the transmission towers by insulating materials. The cost of constructing a new transmission line ranges from $500,000 to $1 million per mile,[20] with the line's conductors alone representing between 20% and 40% of the total cost.[21] As a result, it is significantly

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[12]IEEE Power Engineering Society, 1996, 3. According to the same source, an electric power system is "the generation, transmission, distribution, and other facilities operated as an electric utility or a portion thereof." Ibid., 4.

[13]Wisconsin Public Service Commission, October 1995, 43.

[14]Joskow, 1995, 20.

[15]This characterization could be disputed. We use it because it is illustrative and because the debate on defining transmission system functions has not yet reached consensus For example, see: Hirst and Kirby, 1995.

[16]North American Electric Reliability Council, September 1995, 23.

[17]Ibid. As of 1993, there were 642,377 circuit miles of 22 kV or higher power lines in the United States. Source: Edison Electric Institute, 1993, 97.

[18]In order to eliminate the "corona problem," multiple conductors for each phase are often used.

[19]Kelly et al, 1987, 16.

[20]Factors such as number of circuits, terrain, population, and type of structure used account for the large variation in cost. Source: FERC, 1989, 46.

[21]Orawski, 1993, 222.

less expensive to add a second circuit to an existing line than to build an entirely new set of structures when new capacity is needed.

Table 2.2 Relative Load Carrying Capacities of Transmission Lines

Voltage (kV)	Year Introduced on American grid	Maximum Power Capacity (MW)
230	1920s	200
345	1952	550
500	1964	1200
745	1969	2700

Sources: Federal Power Commission, 1964, Vol. 1, 149-151
Edison Electric Institute, *Statistical Yearbook of the Electric Utility Industry,* various years

Improvements in transmission technologies (in the form of higher voltage lines) significantly expanded the feasibility of transferring large quantities of power, and in the process allowed for increased exploitation of power pooling benefits.[22]

2.4.2.2.2 Ancillary Services

Ancillary services are "those services necessary to support the transmission of energy from resources to loads while maintaining reliable operation of the transmission provider's transmission system in accordance with good utility practice."[23] In short, they are the "glue" that hold the transmission network together.[24] The Federal Energy Regulatory Commission (FERC) has identified six ancillary services:[25]

- Reactive power/voltage control: providing or absorbing reactive power by reactive power generation or static devices;
- Loss compensation: generating power to replace power lost in the transmission system;
- Scheduling and dispatch: unit commitment and economic dispatch;[26]
- Load following: automatic generation control;[27]
- System protection service: spinning reserves, stand-by reserves, transmission reserves, and local area security; and
- Energy imbalance service: compensating for differences in the scheduled and actual power flows.

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[22]See Section 2.6.3.1.
[23]IEEE Power Engineering Society, 1996, 2.
[24]Ilic´ and Graves, August 1995, 1.
[25]FERC, April 1995, 17683-17685.
[26]For a definition of these, see: 2.4.2.1.3.
[27]For a discussion of this, see: 2.4.3.1.

The concept and definition of "ancillary services" is relatively new. In the current industry structure, each of these (often interrelated) functions is provided by vertically-integrated utilities (where the generation and transmission provider are one in the same). However, some of these "transmission" services -- such as loss compensation, dynamic reactive power/voltage control, and load following -- are provided by generating plants. If generation and transmission are unbundled,[28] the situation will become more complicated. Defining ancillary services,[29] let alone ensuring their provision, is one of the most technically complicated undertakings in the restructuring process.

Several of the ancillary services are part of the transmission function we call system control, to which we pay special attention here.

2.4.2.2.3 System Control

System control pulls together the various transmission system sub-components. This occurs in an ECC, where the system controller estimates power needs, schedules and dispatches generating facilities, and makes appropriate adjustments as system events (including emergencies) occur. The goals of system control are to maintain reliability (keep the system together) and to produce and deliver power in an economically efficient manner. Several system control tasks are of particular interest to this thesis.

2.4.2.2.3.1 Unit commitment[30]

The system operator's initial attempt to match load with appropriate generating capacity in an economic manner occurs during unit commitment, in which the system operator schedules plants in hourly blocks with an advance time horizon of one day to one week. The two primary unit commitment tasks are:[31]

- Scheduling the on and off times of generating facilities; and
- Ensuring that startup and shutdown rates, and minimum up and minimum down times are considered.

Factors that are considered in unit commitment decisions include:[32]

- Maintenance scheduling;
- Nuclear refueling and production scheduling;
- Daily load forecasting;
- Hydro and pumped storage production scheduling; and
- Reliability analysis.

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[28]Generation and transmission are operated by separate entities. As is seen later in the thesis, such a move seems inevitable.

[29]There is not a consensus that the FERC has a complete list. For a critique of the FERC's list and proposition of additional services, see: Hirst and Kirby, 1995.

[30]The information for this section comes from Gruhl *et al*, 1975.

[31]Gruhl *et al*, 1975, 116.

[32]Ibid.

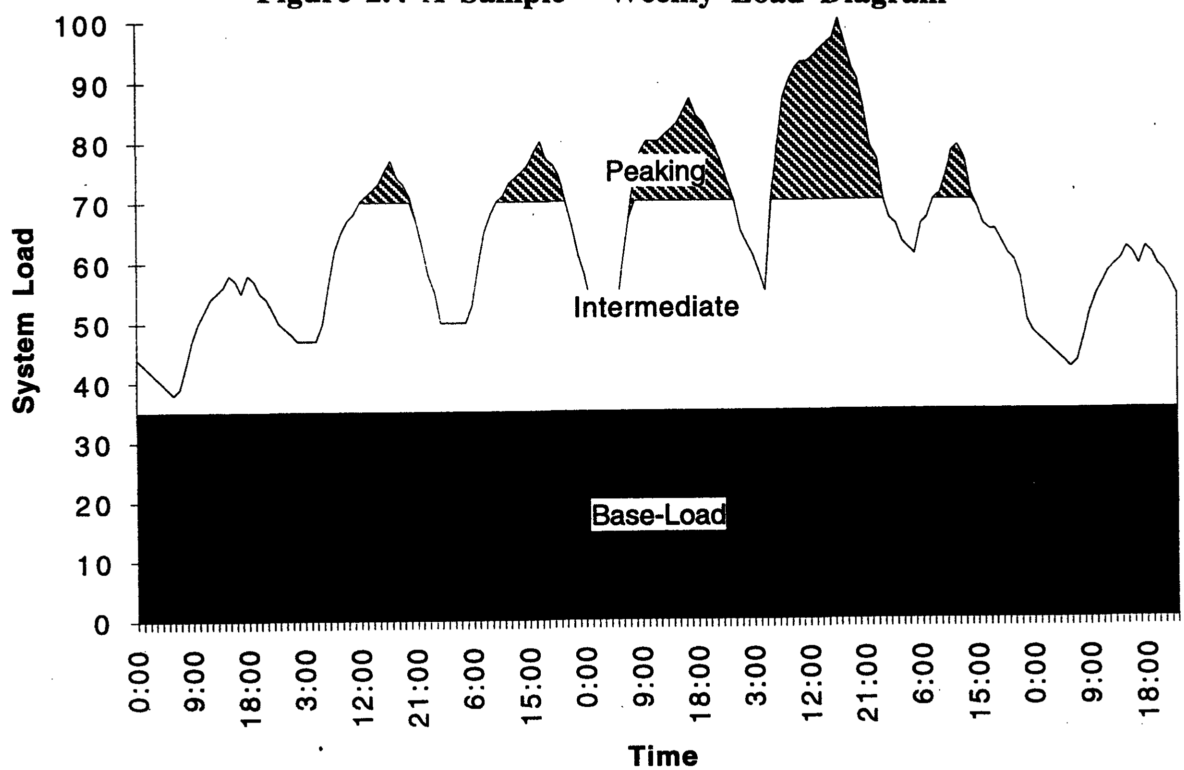
Depending upon how the industry is restructured, some, if not many of these unit commitment (planning) functions might be eliminated, at least on a centralized basis. Doing so, while retaining system reliability, would be a non-trivial technical challenge that is not fully appreciated by many who advocate rapid, radical deregulation.

2.4.2.2.3.2 Economic Dispatch

The considerations taken into account for unit commitment are also important for economic dispatch, which entails administering the output of generation assets on a time scale of minutes and seconds. According to the FERC,

> "Economic dispatch" refers to the process of operating the various resources of the system so as to minimize costs... The ongoing problem is to determine, preferably on a continuous basis, the combination of generation resources, including purchases over the interconnections, which minimizes overall electrical energy production costs while maintaining reliability...
>
> When two or more generating utilities are dispatched as a single control area, the process is known as "central dispatch."[33]

Figure 2.4 A Sample[34] Weekly Load Diagram



In order to do this in the current electric power industry, the system controller must know the production cost structure of each plant in the control area. As the FERC notes,

[33]FERC, 1981, 27.

[34]The data in this figure was made-up by the author in attempt to illustrate the point.

> The incremental cost of producing an additional kilowatt-hour on any electric generator depends upon the characteristics of the unit... The minimum control area production costs will occur when every on-line generating unit has an incremental cost no greater than the incremental cost of any block of generation not already loaded. The value of common incremental cost at any time is referred to as the "system lambda." It is a function of economic dispatch to determine the proper loading on each unit such that the total load is met at the lower possible production cost consistent with other necessary constraints, such as transmission line loading, transmission losses, spinning reserve requirements, and environmental considerations.[35]

The result of economic dispatch is that generators with low marginal costs, such as nuclear plants, are run essentially all of the time. These are referred to as base-load plants. Others, "intermediate" and "peaking plants," are turned on and off by the system controller, based upon the plants' incremental production costs and changes in demand. (See Figure 2.4) In deciding which plants should operate, the system controller performs optimal load flow calculations.

We briefly explore the mathematics of these calculations by outlining their use on a system with 5 transmission lines, two generators, 2 interconnections (to other transmission systems), and three distribution system loads. (For a visual depiction of such a system, see Figure 2.3.) The goal of economic dispatch is to minimize the total production cost:

$$\min T_c = \min \sum_{i=1}^{4} c_i(P_{Gi})$$

Subject to: $P_G = P_D + P_L$

(Equation 2.1)

where:

T_c = Total cost

P_{Gi} = Real power production at bus (generator) i (or power coming from an interconnection)

$c(P_{Gi})$ = Production cost of P units of power at bus i.

P_{Dj} = Demand at bus j

$P_{Lk}(P_{G1}, P_{G2}, P_{G3}, P_{G4}, P_{D1}, P_{D2}, P_{D3})$ = losses along line k based upon the generation and demand but neglecting transmission line limits

$$P_D = \sum_{j=1}^{3} P_{Dj}$$

$$P_G = \sum_{i=1}^{4} P_{Gi}$$

[35]Ibid.

$$P_D = \sum_{k=1}^{5} P_{Lk}\,.$$

(Note: This is a simplified case since it does not consider transmission line constraints.)

To find the solution, we solve the Lagrangian:
$\mathcal{L}(P_{G1}, P_{G2}, P_{G3}, P_{G4}, \lambda) = c(P_{G1}, P_{G2}, P_{G3}, P_{G4}) + \lambda\,(P_D + P_L - P_{G1} - P_{G2} - P_{G3} - P_{G4})$

(Equation 2.2)

From this, it can be shown that system lambda, $\lambda^* = \dfrac{\dfrac{\partial c_{Gi}}{\partial P_{Gi}}^{*}}{(1 - \dfrac{\partial P_L}{\partial Gi})}$

(Equation 2.3)

When a further simplifying assumption is made (transmission losses are neglected), it can be shown that optimal dispatch occurs when:

$$\lambda^* = \frac{\partial c_{G1}}{\partial P_{G1}} = \frac{\partial c_{G2}}{\partial P_{G2}} = \frac{\partial c_{G3}}{\partial P_{G3}} = \frac{\partial c_{G4}}{\partial P_{G4}}.$$

(Equation 2.4)

These solutions indicate that least-cost production occurs when the marginal costs of all dispatched generators are equal, or, in the case of Equation 2.3, when the marginal costs are equivalent when transmission losses are considered.

2.4.2.3 Interconnected Grids

To complete the "atomic" analogy, control areas are the building blocks of the interconnected grids. Control areas in the Continental United States and much of Canada and Mexico are interconnected into three larger systems: Eastern System (essentially east of the Rocky Mountains), Western System, and Texas System.[36] Within an interconnected grid, the ECCs are responsible for maintaining reliability and balancing electricity supply and demand in their own control area. However, they can turn to each other to meet some of their supply needs during emergencies or through planned transactions.

[36] By having its own system, Texas escapes federal regulation of transmission.

While control areas could function independently, the grid has been interconnected for important reasons, which include:[37]

- Reserve capacity sharing;
- Improved reliability;
- Economic dispatch;
- More optimal capacity expansion; and
- Joint planning and maintenance.

Interconnections between control areas can also:[38]

- Provide flexibility for contingencies;
- Reduce installed generating capacity; and
- Allow economic sharing of generation among systems.

These benefits can be broken down into two closely-related broad categories: coordination for reliability and coordination for economy.[39] Interconnection increases reliability because of its larger "pool" of generators (compared to a single system). As a result, a control area has the resources of multiple systems at its disposal when the need for a contingency supply arises, and probabilistic characteristics of large pools are also more favorable. Interconnection is economically desirable because a utility can partially rely on others for emergency and non-emergency[40] contingencies, and therefore, it needs less reserve capacity. Interconnection also allows for *de facto* economic dispatch of multiple utility systems by facilitating beneficial power trades. Increasingly active wholesale power markets have resulted from interconnections. Estimates place the value of wholesale wheeling at $57 billion, up 40% over the past five years.[41]

2.4.3 Physical Laws of Transmission Systems

The need for ancillary services and system control stems from the fact that transmission systems, like all systems, obey physical laws. In the case of electric power systems, however, the intimate relationship between the various system components and the wave nature of electricity make the physical laws of system operation more constraining than for almost any other production system. Let us examine several of the important "special" physical laws of electric power systems.

2.4.3.1 Instantaneous Balancing of Generation and Load

An important constraint on electric power systems is that the amount of power generated must match load on an essentially instantaneous basis. This constraint results from the

---

[37]Nelson, 1974, 19-27. A much more extensive list is presented by the FERC. See: FERC, 1981, 15-16.
[38]North American Electric Reliability Council, 1990, 28.
[39]FERC, 1981, 2.
[40]Such as taking a plant off-line for maintenance.
[41]Source: "Open Access Not Good For Everyone..."

inability to store power economically, and has profound consequences for the industry. Two of these consequences are the system operator's unit commitment and economic dispatch functions, which "coarsely" and "finely" match generation with load, respectively. For the "finest" adjustments, "natural" physical components, such as automatic generation controllers (AGCs), work to match demand and load on an nearly instantaneous basis.[42] Another significant consequence is the need for spinning and standby reserves, which can be called upon in the event of an emergency on an instantaneous and 10-minute time scale, respectively. These two sets of consequences are among many that result from this physical constraint.

2.4.3.2 Path of Least Impedance and Loop Flows

Electricity flows along the path of least impedance (rather than the path of least distance). This physical law and the fact that "the electric grid was built purposely without “valves” to capture the huge reliability benefits that come from allowing nature -- not contracts -- to manage the flow,”[43] makes electric power systems different from nearly any other production system. In particular, power flows are guided by time-variant complex physical interactions, subject only to indirect human control (through adjusting power generation) on a normal operating basis.[44] As a result, “loop flows” occur -- when power is sent over the grid, some of it will go along the geographically “most direct” path, but some of it will go along other "parallel" lines,. This has significant implications when attempts are made to assign responsibility and recovery for the flows of power transactions. A recent report by the North American Electric Reliability Council (NERC) states,

> Electric power transfers in ac systems will be distributed, in varying degrees, on all transmission paths between two areas. The resultant transmission line loadings will be in accordance with known electrical network relationships, but may not be in accord with any contract or agreement that established the scheduled transfers between the two areas.
>
> When such electric power transfers between two areas distribute onto the facilities of other interconnect systems not contractually (or directly) involved in the agreement between the transacting parties, the unintended electric power flows on these neighboring or adjacent system facilities are known as "parallel path flows." In some cases, the parallel path flows may result in transmission limitations in the neighboring or adjacent systems, which can limit the transfer capability between two contracting areas.[45]

---

[42] For more details, see: Ilic´ *et al*, 1996, 63.
[43] Hogan, 1993, 19.
[44] In the case of emergencies, system controllers can "disconnect" transmission lines.
[45] NERC, May 1995, 13.

The result is that the same deleterious impacts (heightened transmission losses, and the potential for reactive power and congestion problems) that are felt along the "primary" path also occur along these parallel flow paths. However, if contracts are written so that only the utility over whose transmission system a power transaction is theoretically wheeled (based upon a legally defined "contract path") receives compensation, the neighboring and parallel utilities, over whose lines some or much of the power might actually flow, would not be equitably treated.

2.4.3.3 Reactive Power

Real and reactive power flow across transmission lines. Although real power is what is intentionally produced and what is used for useful purposes, reactive power cannot be ignored. Theoretically, reactive power is the imaginary part of the power function,

$$P(t) = V\,I\cos\phi(1+\cos(2\omega t)) + i\,V\,I\sin\phi(2\omega t).$$

(Equation 2.5)[46]

Reactive power is produced (or consumed)[47] when the AC voltage and current waves become out of phase[48] as the result of either wave being retarded by system loads or other equipment (including transmission lines themselves). Reactive power results in real power losses, and in extreme cases, damages system equipment. As a result, reactive power production and consumption devices (inductors and capacitors) are placed on the system. Some of these are static (such as capacitor banks on long transmission lines) while others are dynamic (reactive power generated in power plants).

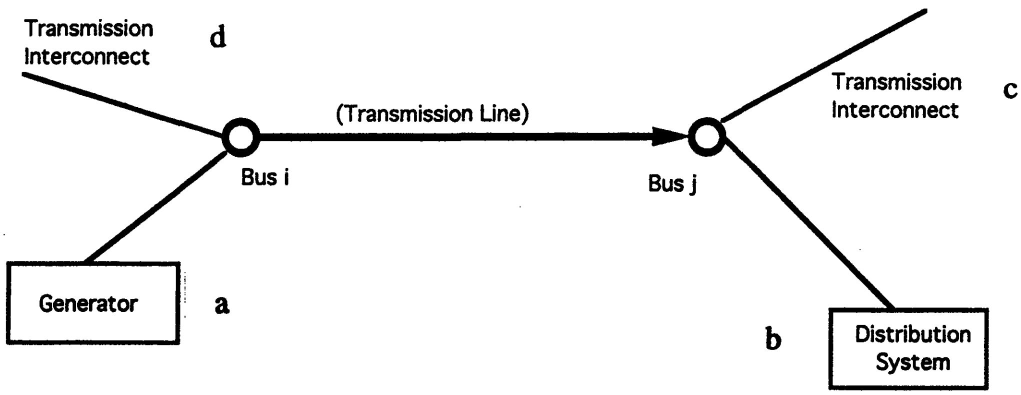
2.4.3.4 Counterflows

Because power flows through transmission systems without respect for contracts, if *party a* were to send power across a line in one direction (for example, in Figure 2.5 from bus i to bus j) to *party b*, and *party c* were to send an equal amount of power in the opposite direction (from bus j to bus i) to *party d*, the power flows would be different from what might be expected. Instead of "crossing" each other, the power flows would essentially cancel out each other (at least as far as the line is concerned). Conceptually (although not completely true technically), *party a* would send power to *party d*, and *party b* would receive power from *party c*. This is a beneficial result, as it lowers the transmission line's

[46]Ilic´, 18 September 1995.
[47]Some devices and loads produce reactive power while other consume it.
[48]For a more thorough discussion, see: Kelly *et al*, 1987, 30-32, 277-280.

loading (which allows for additional power to be sent across it) and lowers the resistive losses that occur on the line.

Figure 2.5: A Sample Transmission Line



2.4.3.5 Transmission Losses

Power is dissipated by resistance as it flows through transmission lines. It can be shown that the real power dissipated by resistive losses as power flows from bus i to bus j across the transmission line depicted in Figure 2.5 is:

$$P_{loss} = G\left(V_i^2 + V_j^2 - 2V_iV_j\cos(\delta_{ij})\right) \qquad \text{(Equation 2.6)}^{49}$$

where:
- G = The conductance of the line
- V_i = Voltage at Bus i
- V_j = Voltage at Bus j
- δ_{ij} = Phase angle difference between buses i and j

As is seen in the above equation, resistive power losses depend upon several variables. In general, one to six percent of the power flowing through a transmission line is dissipated by resistive losses.[50] Losses increase as a line is more heavily loaded.

In addition to resistive losses, reactive power losses occur as electricity flows across transmission lines. It can be shown that the reactive power loss across the transmission line depicted in Figure 2.5 is:

$$Q_{loss} = B\left(V_i^2 + V_j^2 - 2V_iV_j\cos(\delta_{ij})\right). \qquad \text{(Equation 2.7)}^{51}$$

[49] Ilic´, 20 September 1995.
[50] Office of Technology Assessment, 1989, 121.
[51] Ilic´, 20 September 1995.

where: B = The susceptance[52] of the line
V_i = Voltage at Bus i
V_j = Voltage at Bus j
δ_{ij} = Phase angle difference between Buses i and j

While reactive power losses are rarely mentioned, they can be an order of magnitude higher than the resistive losses under certain conditions.[53]

2.4.3.6 Transmission System Reliability Limits

In addition to obeying these physical laws, transmission systems must be operated within three sets of limits in order to ensure system integrity (i.e. reliability). NERC describes these (and the consequences for violating them) as follows:[54]

- Thermal limits -- Thermal limits establish the maximum amount of current that a transmission line or electric device can conduct before it sustains permanent damage by overheating; and
- Voltage limits -- Adequate voltage must be maintained on the transmission systems at all times... Voltage limits establish the maximum amount of electricity that can be transmitted without causing damage to utility or customer facilities, or a "voltage collapse." The result of a voltage collapse is a blackout; and
- Stability limits -- All generators on an AC transmission system operate in synchronism with each other... Immediately following a system disturbance, generators begin to oscillate relative to each other, causing fluctuations in line loading and system voltages... If a new, stable operating point is not quickly established, the generators will lose synchronism with one another, and portions or all of the electrical network may become unstable. The result may be damage to utility equipment and the interruption of electric supply to customers.

It should be noted that some of these limits are soft -- while the constraints are real, the limits within which transmission systems are expected to operate[55] are somewhat arbitrary. Traditionally, significant safety margins have been built into transmission operation in order to ensure system integrity. This reliability comes at a cost, however. Consequently, renewed debates over appropriate safety margin levels are likely to occur as the industry becomes more competitively-driven.

2.4.3.7 Congestion

A transmission line is said to be congested when it is loaded to its thermal limit (or close to it). One potential negative consequence of congestion is out-of-order dispatch (plants with marginal costs above the theoretical system lambda must run to meet demand because the

[52]The susceptance is a function of a line's inductance and resistance.
[53]Ibid.
[54]North American Electric Reliability Council, 1992, 20.
[55]The standards are set by the North American Electric Reliability Council.

congestion has blocked power from less expensive plants). Another is that congested lines dissipate power (in the form of resistive line losses) at a higher rate than uncongested lines.

2.4.4 Purpose of Transmission Systems -- Why Is Transmission Important?

The most obvious purpose of transmission systems is to physically deliver power from generators to loads. In other words, on a purely technical level, the two primary roles of the transmission grid is to:[56]

- Serve as a conduit for power flows between generation and load busses; and
- Provide voltage/reactive power support by means of distributed devices that are located throughout the system.

However, as a result of the technical and economic complexities of electric power production and delivery, transmission systems do much more than this. As Joskow and Schmalensee comment, "Transmission plays the most fundamental role in achieving the economies of scale that modern technologies make possible."[57] We have witnessed this in many ways in this chapter. From the economic interchanges made possible by interconnected transmission systems to the increased reliability that occurs when the generating resources of multiple control areas are combined (rather than customers being served by just one local plant), the transmission system plays a crucial integrating role in the electric power production and delivery process.

2.4.5 Economic Issues and Principles

There are two economic issues and principles that are especially important to transmission systems, especially as the industry becomes more competitive.[58]

2.4.5.1 Spot Pricing

In 1988, MIT's Fred Schweppe *et al* published a revolutionary book, *Spot Pricing of Electricity*. In essence, the MIT group took the concept of economic dispatch, recognized that the cost of system operation varies significantly over time, and developed a pricing scheme that accounts for this. By making several adjustments to the system lambda concept (see Equations 2.3 and 2.4), Schweppe *et al* defined the marginal cost of serving the *k*th customer during hour t, and equated that to the market's spot price [$\rho_k(t)$].[59] According to their formula,

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[56] Ilic´ and Graves, August 1995, 6.
[57] Joskow and Schmalensee, 1983, 63.
[58] More economic issues are discussed in Chapter 9 and Appendix J.
[59] Schweppe *et al*, 1988, 34

$$
\begin{aligned}
\rho_k(t) = \;& \gamma_F(t) && \text{Generation marginal fuel}\\
+\;& \gamma_M(t) && \text{Generation marginal maintenance}\\
+\;& \gamma_{QS}(t) && \text{Generation quality of supply}\\
+\;& \gamma_R(t) && \text{Generation revenue reconciliation}\\
+\;& \eta_{L,k}(t) && \text{Network marginal losses}\\
+\;& \eta_{QS,k}(t) && \text{Network quality of supply}\\
+\;& \eta_{R,k}(t). && \text{Network revenue reconciliation}
\end{aligned}
$$

(equation 2.8)

Several elements of the spot price can be grouped into larger components:

$$
\begin{aligned}
\lambda(t) &= \gamma_F(t) + \gamma_M(t) && \text{System Lambda}\\
\gamma(t) &= \lambda(t) + \gamma_{QS}(t) && \text{Marginal value of generation}\\
\eta_k(t) &= \eta_{L,k}(t) + \eta_{QS,k}(t). && \text{Marginal value of network operation}
\end{aligned}
$$

(equation 2.9)

With the spot price established, customers can be charged electricity rates that change with time (on the order of minutes or hours) instead of being charged time-invariant rates (prices adjusted on the order of years). In the extreme, spot pricing would allow for almost instantaneously changing rates. However, the authors propose that a hourly spot price be used.[60] A half-hourly spot pricing system has been used in Great Britain since 1990.

A benefit of spot pricing is that it gives customers incentives to adjust their electricity consumption away from peak times. In terms of Figure 2.4, spot pricing seeks to fill the troughs in the demand curve with some of the peaks through economic signals. Since the "peaking" plants have high marginal costs, such a shift in demand would significantly reduce total marginal production expenses even if total demand were to stay constant.

2.4.5.2 Equalization of Marginal Costs

A fundamental economic principle of electric power system operation is that "the marginal cost of generating electricity at any two locations should differ by no more than the marginal cost of transmitting electricity between them,"[61] otherwise known as equalization

[60]Ibid., 31.
[61]FERC, 1989, 86.

of marginal costs across the grid.[62] A more thorough discussion of this topic occurs elsewhere.[63]

Having now examined some important technical and economic characteristics of electric power systems, let us turn our attention to how the electric power has evolved to being on the verge of competition.

[62]Kelly *et al*, 1987, 138.
[63]See Sections 9.3.2 and 9.6.

Chapter 3
The Evolution Toward Competition In The Electric Power Industry

Indeed, competition was so thoroughly recognized at the beginning of the industry as proper and possible that in some cases general franchises were granted to all companies describing to supply electric light and power.[1]

-- Delos F. Wilcox (1910)

3.1 INTRODUCTION

The history of the American electric power industry has been characterized by continued technological development and complex interactions between the government and private firms. Although the deregulation of the industry which is now occurring represents a major break from the industry's past structure, it is nevertheless a continuation of the industry's evolution. This chapter explores the historical events which are crucial for understanding the issues involved in today's restructuring, discusses the events of the past two decades in the context of a policy-making framework, outlines several current and future issues that are specifically related to transmission, and offers a brief perspective on the industry's future.

3.2 THE INDUSTRY PRIOR TO 1978[2]

3.2.1 The Early Years

3.2.1.1 The Industry's Beginnings

The electric power industry has its roots in the work of Thomas Edison, who, in September 1882, began to generate and sell electricity at the Pearl Street Station. In its early years, the industry consisted of many small firms which served a limited area, often in competition with each other, and were operated under the purview of local (city) authorities.[3] Around the turn of the century, as transmission and generation technologies improved, some people recognized that there were economies of scale in electric power

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[1]Wilcox, 1910, 142.

[2]This chapter assumes a high familiarity with the industry's history and presents many concepts briefly. A more detailed history can be found in Appendix B.

[3]For example, 47 electricity company franchises were granted in the city of Chicago between 1890 and 1905. (Only a handful of these were city-wide, the remainder were for sections of the city.) Source: Wilcox, 1910, 143.

production and distribution. Consequently, consolidation began to occur and utilities were granted exclusive franchise territories.

3.2.1.2 The Industry Takes On its Fundamental Features

This era laid the foundation for several fundamental, interrelated features of the electric utility industry: vertical integration, natural monopoly, regulation, and investor-owned utilities (IOUs).[4] It should be noted that these four features are generalizations which were true of most, but not all of the American electric power industry. Vertical integration means that one entity generates, transmits, distributes, and sells electric power to the customers within its service territory.[5]

Natural monopoly means that it is cheaper for one utility to perform these functions than for multiple, competing firms to do so. Until recently, the economies of scale that drove the natural monopoly structure existed in each of the industry's segments and were further entrenched by technological improvements.[6] Of particular significance was the long-lived trend that new generation technologies made increasingly larger generators less expensive per unit output.[7] Similar trends also occurred in transmission.

In the United States, unlike in most other countries, ownership of the electric power industry has largely stayed in the private sector in the form of IOUs. Although the 250 IOUs are outnumbered by 2005 publicly-owned utilities and 939 cooperatives,[8] IOUs generate and distribute more than 75% of the nation's electric power.[9]

Because of the industry's natural monopoly characteristics, these private firms have traditionally been regulated through a rate-of-return (ROR) regulatory process. In an ROR system, a utility receives an exclusive franchise service territory and an obligation to serve all customers located within it on a non-discriminatory basis. The regulatory agency sets the prices that the utility can charge customers in a manner that allows the utility to recover its operating expenses and earn a fair rate-of-return on its capital expenses.[10]

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[4]For more details, see: Appendix B.2.4.
[5]An exception to this has been many of the public utilities and cooperative, 90% of which are distribution-only, and receive their power from other entities, often IOUs. Source: Pierobon, 1994, 19.
[6]At least until recent years when technological innovation has undermined them.
[7]The overturning of this trend is one of the primary forces driving today's deregulation of generation. See Appendix B.6.3.4.
[8]These statistics were for 1994. Source: Energy Information Administration, November 1995a, 8.
[9]Energy Information Administration, November 1995a, 1.
[10]There are other regulatory structures which are similar to ROR in the sense that they feature an exclusive service territory and obligation to serve, but would use different mechanisms for compensating utilities.

3.2.1.3 The Formation of Holding Companies

As new transmission technologies allowed power to be distributed over larger areas, the utilities expanded beyond the confines of cities (and their municipal regulators) and served ever larger territories. To both facilitate and respond to this trend, thirty-three states established regulatory bodies for electric utility oversight between 1907 and 1916.[11] With time, the electric (and gas) utilities continued to consolidate into massive organizations, called holding companies. By 1932, the 16 largest controlled over 75% of the privately owned industry. However, as the utilities grew, the regulatory authorities did not expand with them. The Supreme Court, in a landmark 1927 decision (*Rhode Island Public Utilities Commission vs. Attleboro Steam and Electric Co.*), found that "states could not regulate the price of electricity generated in one state and sold in another."[12] Given the interconnected nature of electric power production and distribution, and since there was no federal regulatory body in place, utilities had incentives to form complicated organizational structures which allowed them to run circles around state regulators during the late 1920s and early 1930s. In addition, some of the holding companies created highly leveraged financial structures, which collapsed during the Great Depression. The legislation that ended the holding company era stated, "the holding company becomes an agency which, unless regulated, is injurious to investors, consumers, and the general public."[13]

3.2.2 The Federal Power Act and the Public Utility Holding Companies Act of 1935

The abuses practiced by the holding companies resulted in a strong backlash against them during the Great Depression. In 1935, two pieces of legislation were passed concurrently, the Federal Power Act (FPA) and the Public Utility Holding Companies Act (PUHCA), with the intent of more effectively regulating the industry.

The latter (PUHCA) was designed to destroy the holding company empires and prevent their reemergence. In the twenty years following the passage of PUHCA, the Securities and Exchange Commission (SEC) separated 759 gas and electric utilities from holding company systems.[14] The holding companies that remained have operated under the stringent oversight of the SEC.[15] PUHCA has had two lasting impacts on the industry. The first is that it created a fragmented industry structure. In order to be exempt from

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[11]Hyman, 1988, 68.
[12]Energy Information Administration, March 1993, 21.
[13]PL74-687, 803-804.
[14]Hyman, 1988, 83.
[15]Today, there are approximately a dozen registered holding companies. Source: "SEC to Propose Repeal of Regulations On Large Utility Holding Companies."

PUHCA, utilities essentially had to either operate only in one state, or to operate a contiguous system over a limited, multi-state area. The result is that today there are approximately 250 IOUs, each with a relatively small service territory. Second, for almost 60 years, PUHCA served as an almost impervious barrier to entry into the industry by non-utility firms. With very few exceptions, non-utilities that entered the industry would become subject to stringent oversight by the SEC in all of their business affairs -- a suffocating prospect to firms operating in competitive industries.

The FPA has also been significant in shaping the industry, serving as the "centerpiece for federal economic regulation of the electric utility industry"[16] One way in which its impact has been felt is in the division of regulatory authority between the states and the federal government. The FPA established the Federal Power Commission (FPC), (which became the Federal Energy Regulatory Commission (FERC) in 1977), and gave it the authority to regulate "the transmission of electric energy in interstate commerce and the sale of such energy at wholesale in interstate commerce."[17] The FPA limited the role of the FPC/FERC to "those matters which are not subject to regulation by the States."[18] Because of the integrated nature of the grid, this authority sharing has evolved over time to mean that the FERC has domain over wholesale power sales and over unbundled transmission tariffs. Such a delineation of authority is an oversimplification, however, and is the subject of continuing contention.[19] In fact, questions relating to the state/federal regulatory interface are crucial issues in the current restructuring debate.[20] The FPA also established principles to guide the FPC's work, the two most important of which are: (1) electric power rates shall be "just and reasonable"[21] and (2) public utilities shall not "make or grant any undue preference or advantage to any person"[22] with respect to any transmission or wholesale power transaction.

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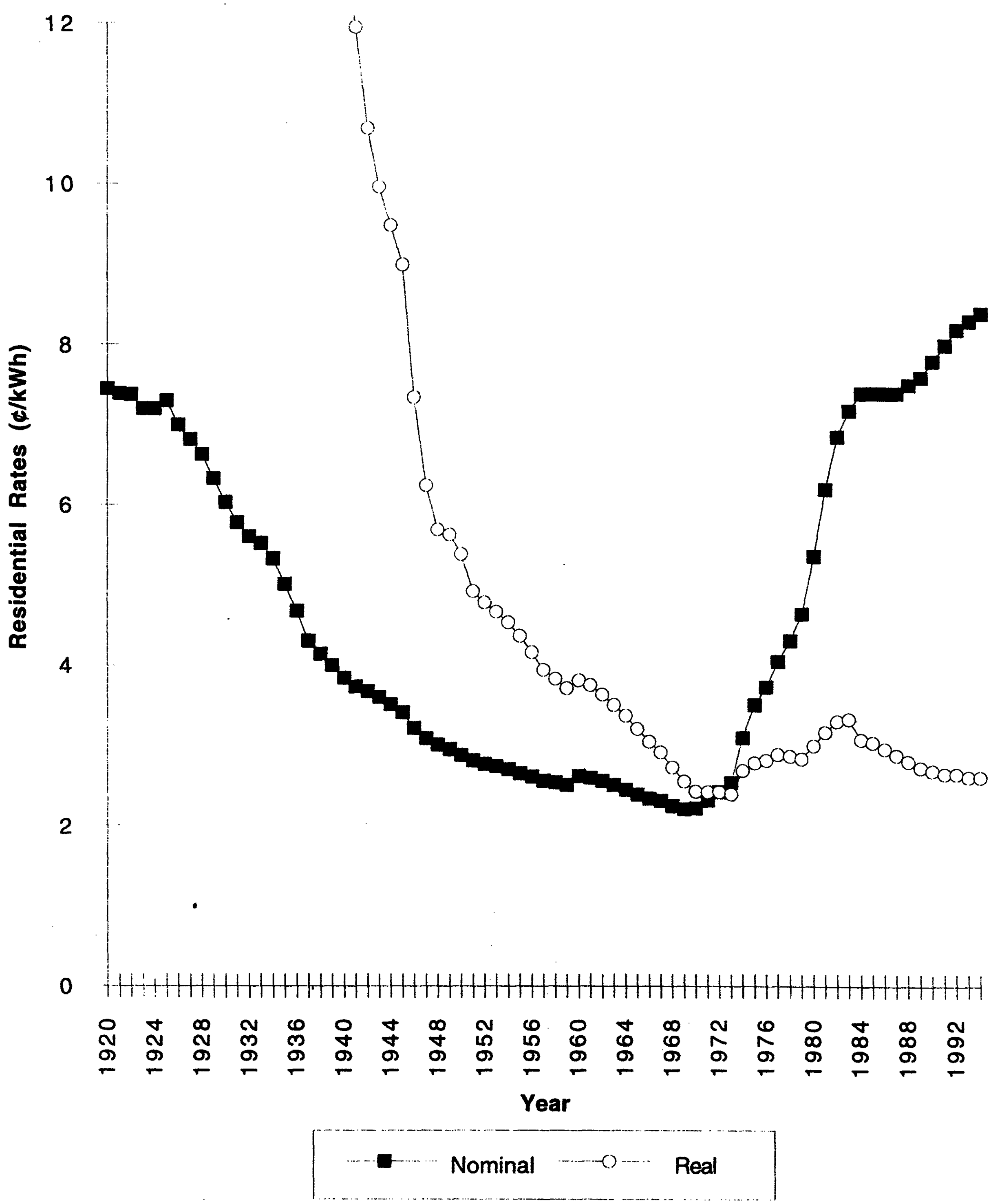
[16]Energy Information Administration, March 1993, 21.
[17]PL74-687, 847.
[18]PL74-687, 847.
[19]For example, see: Kemezis, 1996.
[20]For example, see: "NARUC-FERC Dialog Spotlights Jurisdiction;" "Moler Rattles Peace Saber at NARUC Meeting;" and "Fessler, Tomasky Have a Friendly Joust on Jurisdiction."
[21]PL74-687, 848.
[22]Ibid.

Figure 3.1: Average U.S. Residential Electricity Price, 1920-1994



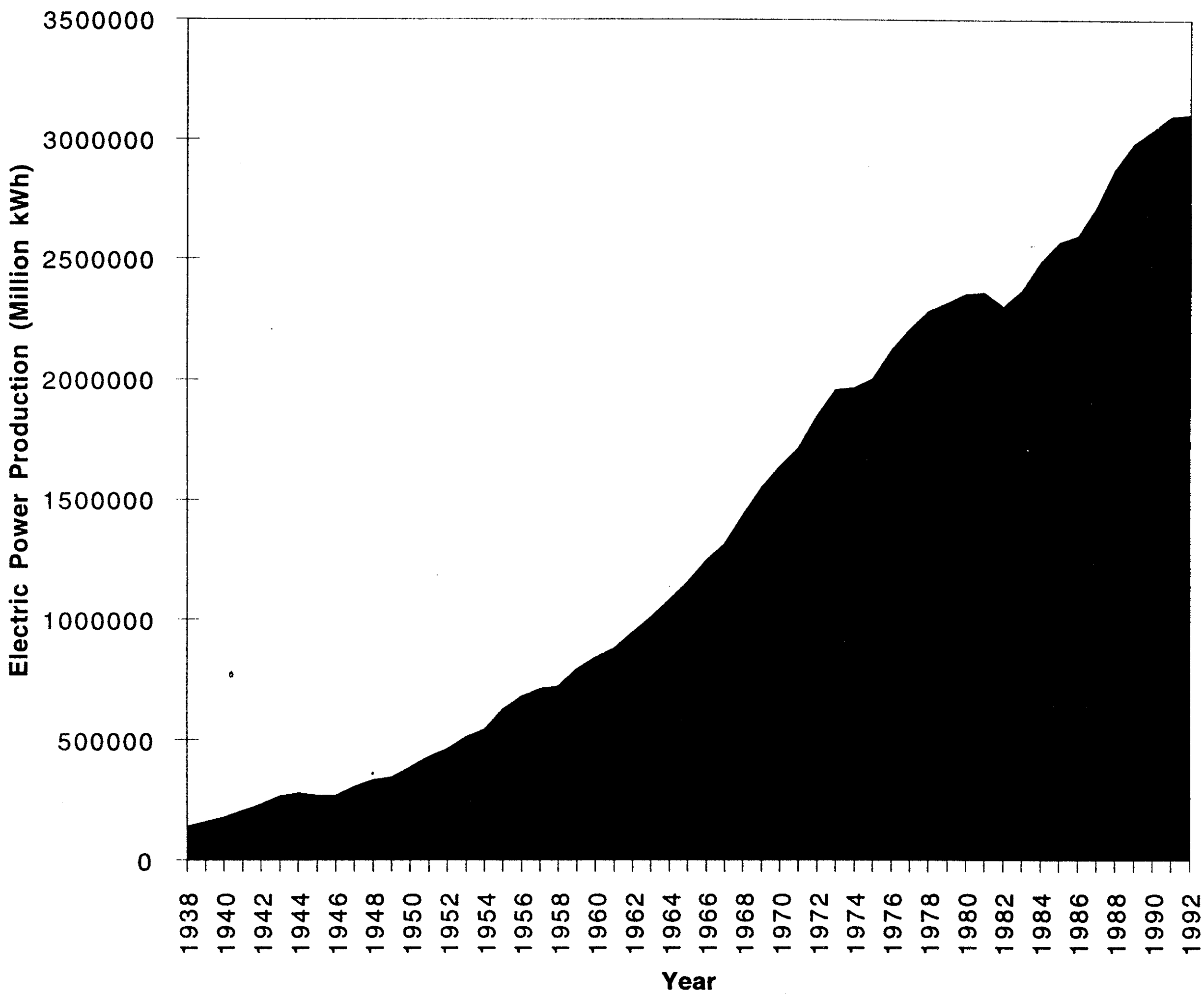
Notes: The "kink" in the graph in 1960 was due to inconsistencies in the data sources. "Real" prices are in 1972 constant dollars.

Sources: Energy Information Administration, 1985, 60-61.
Energy Information Administration, July 1995, 229.

3.2.3 The "Golden Era"

The several decades that followed the enactment of these laws can aptly be called the golden era of the electric utility industry.[23] During this period, the industry was driven by a series of incremental (yet substantial) improvements in generation, transmission, and distribution technologies. As a result, from the industry's birth until the early 1970s, electric power rates fell in both real *and* nominal terms, while the use of electric power skyrocketed (see Figures 3.1 and 3.2).

Figure 3.2: U.S. Electric Power Production, 1938-1993



Source: Edison Electric Institute, *Statistical Yearbook of the Electric Utility Industry*, various years

[23]We intentionally refrain from calling it the golden era of the electric power industry, since that may yet be to come.

3.2.4 The "Golden Era" Ends

Due to a series of events that commenced in the 1970s, the electric utility industry was jolted out of its "Golden Era" and the underpinnings of its regulatory structure began to unravel. As demonstrated by Figures 3.1 and 3.2, electricity became more, rather than less expensive and demand growth slowed markedly. The contrast between the "golden era" and the new era was stark -- in 1963, only three utilities in the country sought rate increases, but in 1975, that number ballooned to 114.[24] But why did this occur?

There is not one answer to this question. A major source of difficulty for utilities was the energy crisis, as Peter Navarro comments,

> In the 1970s, an 'energy crisis' turned this industry upside down, sent electricity prices soaring, and all but unraveled a regulatory compact that had delivered blue chip dividends to shareholders and ever decreasing rates to consumers for over fifty years."[25]

The energy crisis spurred high fuel prices, which increased electricity production costs substantially, which, in turn, led utilities to request rate increases. Although it was clearly an important problem, the energy crisis was only one of many factors that led to the end of the utilities' golden era.

The environmental movement, which entered the mainstream in the late 1960s and early 1970s, increased the environmental compliance requirements of utilities, and in turn, the costs of power production.

Two other exogenous events had a large impact on the industry: high interest rates and high inflation. These were responsible, at least in part, for significant cost overruns on plants that were under construction in the late 1970s and early 1980s. The high interest rates also meant that utilities had to earn a higher rate-of-return on their investments in order to attract capital. These phenomena placed upward pressures on electricity prices.

Limits in technological improvements were also reached during the late stages of the golden era. In particular, the incremental improvements on Rankine Cycle generating plants that propelled the dramatic productivity increases and cost reductions of the golden era reached their thermodynamic limits in about 1960.[26] Subsequent attempts to harness even greater

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[24]Persons, 1995, 36.
[25]Navarro, 1995, 347.
[26]Yeager, 1994.

economies of scale through larger and higher pressure generating plants had mixed, if not inferior results.[27]

Poor demand planning was also a cause of the utilities' problems. Utility planners projected that load growth would continue at its Post World War II 7% annual rate into the 1980s. Instead, the repercussions of the energy crisis -- higher electricity prices, energy conservation programs, and reduced industrial output -- curtailed demand growth to 2%-3% per year. Thinking it was an aberration rather than a start of a new trend, utility planners were slow to adjust. As a result, the utilities continued to build plants, which had up to 10 year construction cycles, to meet a constant 7% growth. When compounded over a number of years, the result was predictable -- significant overcapacity in the early 1980s.[28]

Furthermore, many utilities turned to large nuclear power construction plants in order to meet the projected demand. Unfortunately, many of these plants became boondoggles. While the cause of their problems was quite complicated, a leading contributor was the accident at Three Mile Island which occurred at a time when dozens of the largest plants were being built. Nuclear Regulatory Commission safety regulations written in the wake of the accident delayed construction and mandated additional, expensive safety equipment. These factors, when combined with the lethal combination of high inflation and interest rates during the period as well as mismanagement, led to these plants costing, on average, five times more than the anticipated construction cost.[29]

All of the aforementioned problems put upward pressures on prices in a regulated industry that during its history had only seen rate reductions. Consequently, public utility commissions felt strong pressures from their constituents to resist and minimize rate increases. As a result, the commissions frequently responded to the upward cost pressures by allowing utilities to earn rates of return below what the utilities needed to attract sufficient capital. In more extreme cases, the commissions conducted prudence reviews. Often, these reviews concluded that some or all of a utility's capital expense in question

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[27]Joskow and Rose, 1985.

[28]As is seen later, implicitly if not explicitly, this capacity surplus facilitated more frequent coordination contracts which allowed utilities with high-cost plants to purchase power from less expensive sources, and utilities with high-fixed cost, relatively low marginal cost overcapacity to recover the cost of their plants. With time, these coordination contracts have evolved into a wholesale market.

[29]Energy Information Administration, March 1986. Near the extreme case was Shoreham, in New York, which cost 15 times what was expected. Source: "Long Island Lighting, Still Detested, Nears a Takeover by State."

was an imprudent investment; and as such, could not be recovered through the rate base. Nuclear power plants were a favorite target of prudence reviews. Between 1985 and 1992, electric utilities faced write-offs of $22.4 billion on their nuclear plants.[30]

The final problem of utilities was that their productivity growth, which had been one of the best of all industries through most of the century,[31] suddenly slowed and actually reversed. For example, labor productivity declined more than 10% between 1977 and 1982.[32]

This litany of problems set the stage for a major structural change in the industry. However, since the industry was firmly entrenched, change was not guaranteed. A relatively obscure provision in President Carter's 1978 national energy policy served as the catalyst that set in motion the forces for restructuring the industry.

3.3 ELECTRIC POWER DEREGULATION: A PUBLIC POLICY CASE STUDY

3.3.1 Motivation for this Discussion

The unfolding story of electric power deregulation is a public policy issue of substantial import. The story is interesting not only because of the industry's financial importance and its ubiquitousness in modern society, but also because it is a story about a changing relationship between an important quasi-public industry and the government. At least two benefits could be garnered from analyzing this story as an evolving public policy-making adventure. First, understanding what has happened in the past within the industry could be helpful in planning where it should go in the future. This is particularly useful for our examination of the prospects for non-utility transmission systems.[33] Secondly, gaining an understanding of this story about technology-driven policy change could increase the understanding of technology-driven policy changes in general.

3.3.2 A Public Policy-Making Framework

John Kingdon[34] developed a useful framework for understanding the policy-making process in his "revised" version of Cohen *et al*'s[35] "garbage can" model of organizational behavior. The work of Cohen *et al* was designed to describe the behavior of "organized anarchies" for which it used university governance as the empirical referent, since

[30]FERC, April 1995, 17669.
[31]Kendrick, 1961, 136-137; and Kendrick, 1973, 79.
[32]Bureau of Labor Statistics, 1985.
[33]See Chapter 11.
[34]Kingdon, 1984.
[35]Cohen *et al*, 1972.

universities can be viewed as "collections of choices looking for problems, issues and feelings looking for decision situations in which they might be aired, solutions looking for issues to which they might be an answer, and decision makers looking for work."[36] Kingdon's framework is especially designed for decision-making in the federal government. He also describes this process as "organized anarchy" with an emphasis on "organized."[37]

3.3.2.1 The Three Streams

The central thesis of the "revised garbage can model" is that there are three "streams" continually flowing: the problem, policy, and political streams. In the problem stream are "problems" -- those conditions that people feel should be altered.[38] Given this definition, there are literally millions of problems in the problem stream at any given point in time.

The policy stream consists of potential "policies." These policies are not necessarily solutions to problems that exist, but rather, they are often ideas on future policies -- "ideas in search of a problem," in the words of Kingdon. For example, during the last years of the utilities' golden era, some economists began to consider electric power deregulation.[39] This example is especially instructive as it demonstrates that ideas in the policy stream need not be connected to a particular problem, and that policy ideas often take a decade or longer to be enacted as "real" policy.[40]

The political stream and its dynamics include factors such as swings in national mood, election results, changes of administration, changes of ideological or partisan distribution in Congress, and interest group pressure campaigns.[41]

3.3.3.2 Open Policy Windows, Coupling, and Policy Change

These three streams are continually flowing with seemingly limitless possibilities for establishing new official policies, which occurs when the streams couple. However, the policy-making ability of any government body is finite. Therefore, until the government rations its time to tackle specific problems (at which time some contents of each of the streams are coupled), these streams and their contents continue to flow through time in

[36]Ibid., 1.
[37]Kingdon, 1984, 92.
[38]Ibid., 119.
[39]For example, see: Weiss, 1975; Primeaux, 1975; and Huettner and Landon, 1978.
[40]Kingdon, 1984, 151.
[41]Ibid., 170.

parallel with little or no policy impact. The streams couple during an open policy window, which is an opportunity for action on a given initiative. During these relatively short periods of time, policy entrepreneurs, "people who are willing to invest resources or various kinds in hopes of a future return in the form of policies they favor,"[42] have an opportunity to promote stream coupling -- to match (or adapt) their policy solutions to the problems that are on the institutional agenda. If policy entrepreneurs do not effectively act during an open window, they must bide their time until the next time the window opens for their issue -- often years, if not decades later.[43]

Policy windows are opened by the emergence of compelling problems or occurrences in the political stream. An example of the latter is the health care legislation that was introduced (and placed at the top of its agenda) by the then-new Clinton administration in 1993.[44] An example of a compelling problem opening a policy window is the Carter Administration's numerous energy-related laws that were developed and passed in response to the energy crisis.[45]

With an understanding of this framework in hand, let us now examine the recent evolution of the electric power industry.

3.3.3 <u>Application of the "Revised Garbage Can" Model to Electric Power Deregulation</u>

The process of applying Kingdon's framework to the electric power industry case is more complicated than to most because of the many decision windows that open, as a result of the split jurisdiction over the industry between Congress, the FERC, and the states. In order to simplify our analysis, we consider the Public Utility Regulatory Policies Act of 1978 (PURPA), FERC's implementation of the Act, and the subsequent state PURPA implementation decisions as one policy decision, the product of the same currents within the three streams. A similar amalgamation is made of the Energy Policy Act of 1992 and the subsequent state and FERC actions with regard to competition.[46]

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[42]Ibid., 151.

[43]Eliminating the federal government deficit is a classic case of this. In 1981 and 1995 opportunities to do so came and went. Sources: Grider, 1981; and "Deficit Politics: Is The Era Over?"

[44]Another example is the barrage of legislation proposed in Congress in 1995, following the resounding Republican victories in 1994.

[45]A more recent example is the debate and eventual decision to start the Persian Gulf War, which was precipitated by the Iraqi invasion of Kuwait.

[46]This amalgamation could be contested because EPAct promoted wholesale wheeling while the state initiatives are generally promoting retail wheeling. However, the same forces are at work, so we will consider them to be one.

3.3.3.1 The Streams Before PURPA

3.3.3.1.1 Political stream

The most important current in the political stream prior to PURPA was the energy crisis that was gripping the nation, which threatened both the lifestyles of individual Americans (such as high gas prices) and the nation's economic well-being, because of the economy's large dependence on foreign oil. President Carter's national energy policy was designed to decrease America's reliance on imported oil. This was to be accomplished through many mechanisms, which included the cogeneration[47] and small power production (renewable energy) provisions in Section 210 of PURPA. These provisions required utilities to purchase electric power from non-utility qualifying facilities (QFs) at a fair price, which was determined later as the utility's avoided cost of production. In Congressional testimony on the PURPA bill, Sen. Gary Hart discussed the benefits of the cogeneration provisions in terms of American dependence of foreign oil, "We waste [through untapped cogeneration possibilities] ... the equivalent of 8 million barrels of oil every day, [which is] more than we import."[48]

A second current in the political stream was the environmental movement. While it was less influential in the late 1970s than earlier in the decade, it was nevertheless a factor in including the renewable energy provisions in PURPA.

3.3.3.1.2 Problem stream

Because of the consequences mentioned above, the energy crisis was also the dominant current in the problem stream.

Another current in the problem screen was the perception that utilities were not sufficiently concerned with conservation and environmental issues. Some environmentalists believed that utilities were dragging their feet on developing and adopting new generation technologies, such as renewable energy technologies, that were environmentally benign[49] and/or which had energy conservation benefits. There was also a concern that utilities were actively encouraging industrial plants which had cogenerators to come onto the grid, which resulted in a long-term declining trend in cogeneration.[50] When the states implemented the

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[47]Cogeneration is the use of "waste" steam from power production for another use.
[48]Hart, 1977, 126.
[49]Or at least not as damaging as coal plants.
[50]Industrial cogenerators produced 15% of the total power in the United States in 1950. By 1977, this figure had dropped to 4%. Source: Energy Information Administration, March 1993, vii.

provisions of PURPA, which occurred after the peak of the energy crisis, the environmental/conservation current became the dominant one in the problem stream.

3.3.3.1.3 Policy stream

In one policy stream current were policies designed to improve environmental quality by reducing pollution.

A second, closely connected current consisted of policies designed to stimulate renewable energy development.

A third policy current, which was not much more than a trickle in the mid-1970s, consisted of policies to deregulate the generation segment of the industry.

When one examines the currents that were flowing in the three streams in the late 1970s, the result of their confluence is predictable: policies that stimulate the development of environmentally friendly, renewable energy alternatives to foreign oil dependence.

3.3.3.2 The PURPA Window

The opening of the policy window for energy issues that ocurred during the 95th Congress (1977-1978) was the results of both a political occurrence and a compelling problem. The compelling problem was the energy crisis, and the former came from President Carter's desire to handle the situation in a comprehensive manner. In short, the public was eager for new energy policies, and the President's national energy policy provided the vehicle for change. As part of this process, a policy entrepreneur was able to include provisions to promote cogeneration and small power production into PURPA,[51] one of five laws that embodied President Carter's national energy policy. These provisions were such a small part of PURPA, an Act designed to promote conservation and revamp the rate structures of utilities, that they barely seemed worth mentioning at the time.[52] Per the previous discussion of the currents in the streams, it was relatively simple for a policy entrepreneur to include the cogeneration and small power production provisions in PURPA in a non-controversial manner, especially since they were included in such a marginal fashion.

The actual passage of PURPA is only one part of the story, however. While the law itself was an important catalyst for the independent power industry, its impact was aided, if not

[51]For more details, see: Appendix B.6.1. The exact entrepreneur is unknown to the author.

[52]For example, in its one page, bulletted summary of PURPA, *Congressional Quarterly Almanac* did not mention the provisions of Section 210. Source: Congressional Quarterly, 1979, 644-645.

facilitated, by the series of implementation decisions made after its passage. The small power production and cogeneration guidelines subsequently proposed and adopted by the FERC were generous. The FERC took the statute's requirement, that rates be just and reasonable to utilities and their customers, not discriminatory against the QFs[qualifying facilities],[53] and not in excess of the incremental cost to utilities of alternative energy supply,[54] and set a standard that a utility must purchase QF power at 100% of the utility's "avoided cost" of power production. Furthermore, some states, such as California, pushed the envelope even farther -- by tying the definition of "avoided cost" to the predicted (rising) price of oil. These implementation decisions created large incentives to enter the "PURPA plant" business. This stimulation of demand led to a tremendous influx of QF developers, and in turn, created incentives for generation technology development.

3.3.3.3 New and Revised Streams Between PURPA and EPAct

Following the passage of PURPA and its implementation, several important events occurred that would affect the future of the industry. In terms of Kingdon's framework, new currents were added to the streams.

3.3.3.3.1 Political stream

PURPA served as the headwaters for a tributary that made its way into the politics stream from which a new current was created: non-utility generators (NUGs). The non-utility power industry was essentially nonexistent prior to PURPA.[55] By creating a new class of generators, PURPA created a new political constituency. Quickly aligning with these new entrants was a cadre of entrepreneurial utilities, such as Virginia Power, who saw opportunities in a more competitive industry. These utilities joined the NUGs who were clamoring for relief from the restrictive rules that had guided the industry since the mid-1930s.[56] As Linda Stuntz comments,

> Since 1978, the independent power industry spawned by PURPA has become a formidable economic and political force in its own right. Not content with being 'boutique' generators, independent power producers (IPPs), including many utilities and their affiliates, sought greater opportunity to participate in generation markets by overcoming the limitations imposed by PURPA and ... PUHCA.[57]

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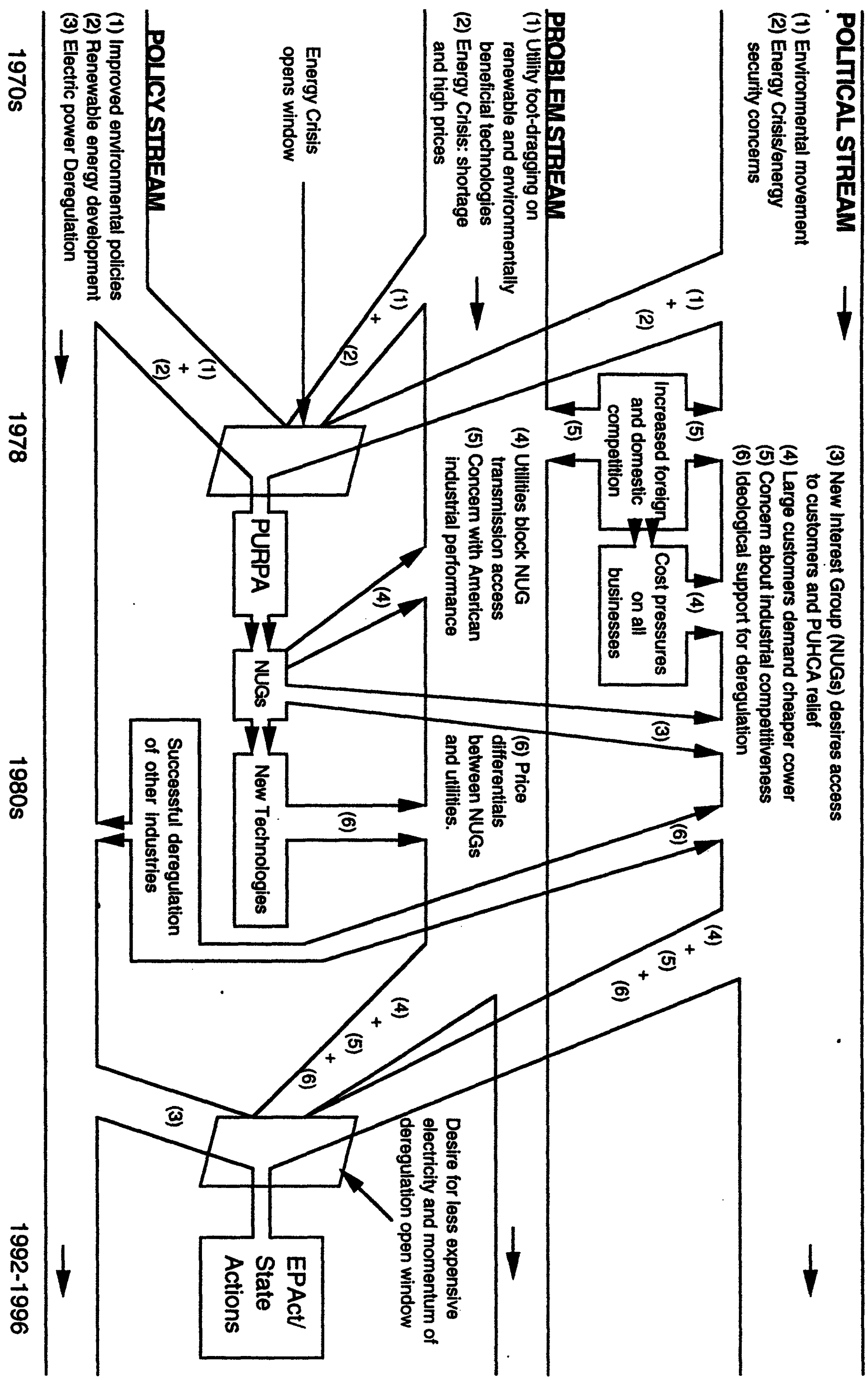
[53] Those facilities which meet the technical and ownership criteria of being a cogenerator or small power producer under PURPA.
[54] Paraphrased from: PL95-617, 3144.
[55] Joskow, 1989.
[56] Dominion Resources, 1989, 14.
[57] Stuntz, 1995, 69.

Figure 3.3: Electric Power Deregulation and the Revised Garbage Can Model



This new constituency worked hard in the early 1990s to eliminate the ownership restrictions it faced as a result of PUHCA, and to gain access to more potential customers.[58]

A second new current in the politics stream was that American industry became more vocal about gaining access to less expensive electric power as it faced increased international and domestic competition. To stay competitive, companies began to look into their budgets to find potential savings. Electricity costs, which had been essentially ignored in corporate accounting, became a target for cost reduction.[59] Large users, which had previously been relatively unconcerned with their rates, began to actively lobby government, through entities such as the Electric Consumers Resource Council (ELCON).

Closely coupled with the lobbying efforts of users was a strong political desire to keep industrial companies competitive. Local and national government policy-makers became concerned with industrial competitiveness as a result of the significant decline of American Industry in the 1980s[60] and the job losses that accompanied it. As a result, when high electricity prices became defined as a problem that inhibits industrial competitiveness, the force of this current pushed for policies to lower rates. This current has been especially strong in states such as California and Massachusetts, where the desire to lower the (high) cost of electricity in order to make manufacturers in these states more competitive with companies from other states[61] and nations has been used as explicit rationale for their trailblazing deregulation proposals.

A third current in the politics stream was ideological -- the belief that competitive markets set prices more efficiently than government regulators. PURPA was passed into law just as the deregulation currents were beginning to spill over from the policy stream into the political stream in the larger society.[62] The currents became increasingly strong during the 1980s and early 1990s as industry after industry was successfully deregulated. By the time

[58]For more discussion of this, see: Appendix B.6.4.
[59]Tabors and Parquet, 1995, 7.
[60]Detailed in Dertouzos *et al*, 1989; and MIT Commission on Industrial Productivity, 1989.
[61]The Massachusetts case is a classic example of this. For example, see: Lester et al, 1995; and "What Do You Mean Taxachusetts?"
[62]As marked by the deregulation of the airline industry. President Carter noted on the signing of the Airline Deregulation Act of 1978, "For the first time in decades, we have deregulated a major industry." Source: Carter, 1978, 1837. PURPA was signed into law on 9 November 1978, only 16 days after the signing of the Airline Deregulation Act (24 October 1978). Quite ironically, the Energy Policy Act of 1992 became law fourteen years later, on 24 October 1992 .

that the Energy Policy Act was debated in Congress in 1992, these free market political forces had become strong drivers of electric power deregulation.

3.3.3.3.2 Problem stream

The strongest current in the problem stream at the time that PURPA was passed into law, the energy crisis, went away several years later. In the 1980s, new currents entered into the problem stream, all of which were partially or directly the result of NUGs. Following the passage of PURPA, QFs were quick to embrace new technologies, including a new generation of gas turbines generators. Many of these new technologies allowed NUGs to produce power at a lower cost than utilities, with their enormous inventory of conventional technology plants. As a result, a new current in the problem stream was the price differential between power produced by many NUGs and the traditional utilities, from whom most customers were forced to buy power.

The price differentials were noticed, and viewed as a serious problem, by manufacturers looking to cut costs wherever possible. As a result, the general "competitiveness" problem of American industry found its way into the problem stream of the electric power industry.

Another problem was that the effectiveness of the new industry participants (the NUGs) was stunted because they were operating within the constraints of an industry designed for 1930s-era electric utilities. While NUGs were producing inexpensive power and adding more than half of the new generating capacity in the country, their growth was constrained in the early 1990s by a market structure designed for franchised monopolies and which, through PUHCA, placed limits on the geographical spread and ownership of individual utilities. Furthermore, in order to reach new customers, NUGs needed to "wheel" power over transmission lines that were owned and controlled by vertically integrated utilities, who often had a financial interest in preventing NUGs from using their transmission facilities. In the early 1990s, these barriers to NUG growth constituted an increasingly strong current in problem stream.

3.3.3.3.3 Policy stream

While no new currents emerged in the policy stream after 1978, the dynamics of those that remained changed greatly. The proposed policies for renewable energy development and for improved environmental policies remained,[63] but the deregulation current became

[63]The latter, as witnessed by the passage of the 1990 Clean Air Act, were much more apt to be coupled into policy than were the former.

dominant by the early 1990s . The deregulation successes in other industries was one contributor for this change in dynamics. Another reason was the successful operation -- both technical and economic -- of QF plants by NUGs. As Richardson and Nordhaus note, "The PURPA program effectively demonstrated the feasibility of a competitive generation sector in the electric power industry."[64] Consequently, the deregulation idea that seemed crazy to many in the 1970s, became accepted and advocated by those in the mainstream of the policy community in the 1990s.

3.3.3.4 EPAct and Subsequent State Windows

3.3.3.4.1 The Energy Policy Act of 1992

In 1992 the policy-making window for electric utility regulation was opened again as a result of several factors. One of them was that President Bush and the Congress believed that it was time to develop a new national energy strategy, especially in wake of the Persian Gulf War.[65] This wide-ranging strategy came in the form of the development and eventual passage of the Energy Policy Act of 1992.[66] The legislative process for this Act became a convenient vehicle for making policy changes across the spectrum of energy issues -- including electric power regulation. On the micro-level, the policy window opened for changes in electric power industry regulation because of the strong currents mentioned above that existed in the problem and political streams. Once the window opened, the problem and political streams coupled with the strong deregulatory current in the policy stream to change the course of the electric power industry.

EPAct provided the statutory authority to ameliorate the "impediments to NUG growth" current in the problem stream through its Exempt Wholesale Generator (EWG) and open access provisions. These changes were made in the context of increasing wholesale power competition.

While the passage of EPAct resulted in some immediate actions -- the FERC received petitions for plants to be declared EWGs within days of the law's signing,[67] and overseas expansion has exploded -- other developments have taken much longer. During the ensuing three and a half years, some progress has been made to increase NUG access to the transmission system, yet the FERC is still enmeshed in a process of making legislative intent become functional reality.

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[64] Richardson and Nordhaus, 1995, 66.
[65] Burkhart, 1992, 72.
[66] PL102-486.
[67] Source: "FERC Approves First EWG Request."

A significant subcurrent in the problem stream that EPAct did not solve (although the law explicitly indicated that states were the appropriate venue for solving it)[68] was the ability of (low cost) NUGs to deal directly with customers, including the large users who desire low cost power. EPAct's non-solution to that problem has allowed the policy window to stay open, while the forum for deregulation has changed from the federal government to the states.

3.3.3.4.2 State initiatives

While for simplicity's sake we are considering EPAct and all of the current state initiatives to be part of the opening of one large conceptual policy window, it should be noted that a more realistic view would be to consider each state as having its own set of streams and own policy windows. Even though the components of each state's streams would be relatively similar (and similar to those of EPAct), each state's streams have different current dynamics.[69] These heterogeneous dynamics result in different deregulation approaches and policies.[70] What is common to all of these debates is that the states are attempting to "couple" the currents in the streams that were not combined by EPAct -- most notably, by granting low-cost IPP generators access to price sensitive customers.

3.3.4 Implications of This Analysis

An important question to ask at this point is, what implications arise from applying the garbage can model to the electric power deregulation case?

The most important lesson from this story is that PURPA was significant because it served as the "headwaters" for several of the important stream currents that coupled fourteen years later in the Energy Policy Act of 1992 and subsequent state deregulation decisions. A implication of this is that the provisions of contemporary deregulation policy decisions will serve as the basis for future (perhaps unanticipated) changes in the electric power industry.

Furthermore, by making reasonable predictions regarding *directions* of future technological change, it could be possible to facilitate the development of (or prevent the foreclosure upon) industry structures that would be more efficient in the future. Efficient industry

[68]PL102-486, 2196-2197.

[69]For example, the policy window opened in California because of generally high utility rates. In Massachusetts, the efforts of one firm did much to pry open the policy window. In Wisconsin, the political stream dominated by a torrential current of deregulation ideology served to open the policy window.

[70]For a more comprehensive discussion of the actions in various states, see Chapter 5.

structures would create incentives for technological development and/or would be accommodating of new technologies, even if the specific new technologies are not known.

A third implication is that the provisions that lead to significant changes in the future need not be integral to the larger policies of which they are a part. For example, PURPA could have easily been passed into law with out the cogeneration and small power provisions. However, they were included in the Act, and the sea-change in the industry that is now occurring is the result.

A final implication is that dynamic factors are important to consider when attempting to shape the industry's future. For example, factors such as new technologies and constituencies were very important in the PURPA-EPAct story. It could be assumed from this that a deregulation proposal that would create new constituencies, with interests that do not parallel those of the current constituencies, has a higher likelihood of instigating further significant structural changes in the future than one which only includes current constituencies.

3.4 ISSUES OF PARTICULAR CONCERN TO TRANSMISSION

3.4.1 Siting Concerns

The difficulty of siting and constructing new transmission lines is a significant constraint on transmission systems.[71] There are several issues that stir public opposition to transmission line construction:

- Aesthetic impacts;
- Environmental impacts; and
- Fear of health risks.

Aesthetically, transmission lines are towering structures that sometimes dominate the scenery and that many people consider unattractive. Environmentally, transmission lines are sometimes built across "environmentally sensitive" areas. For example, there is a significant environmental impact when a line is built through a forest because reliability requires a wide cutting of trees along the line's path. Yet it would not be efficient, nor even practical, to consider building lines without crossing at least some of these areas. Some environmentalists are also concerned with the impact of transmission lines on the health of wildlife.

[71] In fact, the title of a recent *Energy Daily* article compared the difficulties of siting transmission lines with those of siting nuclear power plants. See: "Transmission: The Nuclear Power Problem of the 1990s?"

The "fear of health risks" from transmission lines is a major impediment to transmission line construction. The most significant health risk fear is that those living near transmission lines will contract cancer as a result of exposure to electric and magnetic fields (EMF). The "C" word strikes fear into potential power line "neighbors," and can galvanize resistance to line construction much better than aesthetic or environmental impact concerns. Despite the evidence from "thousands of studies, including 70 epidemiological studies, [that] there is no established cause-and-effect relationship between cancer or other diseases and EMF exposure,"[72] concern remains and transmission projects are often delayed, if not blocked as a result.[73]

The above concerns have made transmission line siting more difficult and could have deleterious impacts on transmission system efficiency. Some states have recently added more complicated certification requirements for lines and are reconsidering past permits.[74] The consequence is that, "The powerful combination of NIMBY and cancerphobia will induce state and local politicians to veto, or to delay interminably, projects that have the potential to yield enormous benefits to millions of electricity customers in an entire region of the country."[75] It is difficult to overcome local concerns for the economic good of a region since the FERC cannot order the construction of transmission facilities, does not have authority over transmission siting decisions, and does not possess the power of eminent domain.[76]

The second manifestation of public concern is tort litigation, which could also serve as an impediment to future transmission line construction.[77] Several recent court cases have dealt with the issue. A lawsuit was filed against Houston Lighting & Power in early 1995 on behalf of 11 families whose children have cancer. However, the suit has since been "nonfiled;" which removes it from the docket but allows the possibility of bringing it back anytime in the next 15 years.[78] A separate, recent Georgia Power Co. victory in an EMF case was overturned by the Georgia Court of Appeals and will be reheard.[79] While a utility

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[72] NERC, 1993, 10; and "Nobelists Dismiss EMF Link." Also see: Palfreman, 1996.
[73]Recently, for example, the New Mexico Public Utility Commission rejected a proposed line in Northern New Mexico at the bequest of its neighbors,[73] a line that the utility claims is necessary to avoid blackouts in the near future. Source: "N.M. Regulators Nix Key PNM 345-kV Transmission Line."
[74]NERC, 1992, 20.
[75] Pierce, 1994, 333.
[76]FERC, April 1995, 17675.
[77]Krieger and Withey, 1994.
[78]Sources: "Electricity, Cellular Phones and Cancer;" and "Joe Jamail Passes (For Now) on Power Line Litigation."
[79]Source: "Georgia Power EMF Victory Overturned."

has yet to lose an EMF case, a Pandora's Box would be opened if that were ever to occur that could have serious implications for transmission systems.[80]

The siting and tort problems could make economically and technically efficient grid expansions increasingly difficult to construct.[81] As the industry moves toward having more interstate wholesale transactions, siting problems may be an increasingly large impediment to a more efficient wholesale power industry, especially since current transmission line siting criteria in most states place little or no value on regional economic benefits or wholesale sales.[82]

3.4.2 Access Issues

Access to transmission systems is a crucial issue in the current deregulation debates.[83] Vertically integrated electric utilities own the vast majority of transmission assets in the United States. In order for power to flow from a generator to a customer, it is necessary to use the transmission network in almost every case. Until the passage of EPAct in 1992, the FERC could not force transmission utilities to wheel power across their lines (although it did use some regulatory "carrots and sticks" to promote wheeling). The result of this situation was predictable, a transmission-owning utility would not allow wheeling across its lines unless it was in that utility's best interest to do so. In particular, if a wheeling transaction would either directly take away a customer from a utility's service territory, or would be used to compete with a utility's own wholesale power sales, the wheeling request of a NUG would be denied.

This situation clearly imposed limits on the ability of NUGs and entrepreneurial utilities to grow and sell less expensive power to customers. In order to alleviate this problem, after long debate and overriding significant opposition by some utilities, Congress passed the open access provisions in the Energy Policy Act of 1992, which gave the FERC the authority to order wholesale (although not retail) wheeling.

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[80] Because of the potential money involved, as long as lawyers see even a remote chance of winning a case, the industry will continued to be dogged by such suits.

[81] This is problematic for a deregulated industry because the transmission grid will be the transportation system for the competitive electric power industry. For a more complete, and excellent discussion of this topic, see: Office of Technology Assessment, 1989, 201-216.

[82] Office of Technology Assessment, 1989, 209.

[83] For example, see: Joskow, 11 April 1996.

Passing a law is one thing, implementing it is another. The FERC began to implement the law on a case-by-case basis, ordering wheeling after petitions were filed and evidence was presented. This process has taken, on average, 9 months for each wheeling request.[84] Realizing that this is not an optimum nor efficient manner to implement open access, in March 1995 the FERC issued a Notice of Proposed Rulemaking (NOPR) on the subject.[85] The transmission access issue and the "Mega-NOPR" are discussed in greater detail later in the thesis.[86]

3.4.3 Pricing Issues

There are numerous ways to price transmission services. However, until recently, the FERC only allowed the use of postage stamp rates.[87] According to the postage stamp method, a fixed transmission charge is levied; the distance that the power moves over a transmission line does not matter. This pricing scheme also assumes that all of the power flows along a defined "contract path" -- which is usually based upon the shortest geographic path across the transmission system. Therefore, only the utility along the contract path is compensated. There are several problems with the postage stamp method that result from the physical properties of transmission systems:

- Power flows over the path of least impedance, not least distance; and
- Power flowing over a line creates effects on the functioning of the system as a whole.

Postage stamp pricing cannot account for either of these significant physical laws.

In its 1994 Transmission Policy Pricing Statement,[88] the FERC expanded the types of transmission pricing structures that it would allow. In doing so, the FERC established five principles, which state that transmission pricing:[89]

- Must meet the traditional revenue requirement;
- Must reflect comparability;
- Should promote economic efficiency;
- Should promote fairness; and
- Should be practical.

The Commission also generated a list of pricing structures that it would accept from individual utilities[90] and from Regional Transmission Groups (RTGs),[91] although it would

[84]FERC, April 1995, 17678.
[85]FERC, April 1995.
[86]See Section 5.5.
[87]FERC, April 1995, 17674.
[88]FERC, November 1994.
[89]Ibid, 55034-55035.
[90](1) Zonal "or" pricing based on power flows from zone to zone within a utility, or within the members of a holding company system; (2) Flow-based line-by-line rates, based on embedded costs "or" pricing; and

consider other pricing schemes as well. Included in these approved mechanisms were distance-sensitive and flow-sensitive pricing. The latter attempts to compensate all of the transmission owners over whose assets the power in question flows. The former compensates transmission owners based upon the distance that the power flows through their segment of the system.[92]

Another major transmission pricing debate concerns nodal and zonal pricing. This topic was fiercely debated during the California deregulation deliberations.[93] Nodal transmission prices are set using the marginal cost of transmission at each bus on the system. Zonal prices are also based upon the marginal cost of transmission, but are less accurate -- they are calculated at the zone-level[94] rather than the bus level.

This overview of transmission pricing issues discusses some of the most important issues, but leaves many others untouched.[95]

3.5 THE FUTURE

While the precise path and pace of electric power restructuring cannot be predicted,[96] it would appear that the continuing move to a less regulated industry is inevitable and the pace of change will likely continue to accelerate. The industry's specific technological and economic characteristics will play a role in shaping the future direction of the industry. However, an equal or greater contribution to the industry's future direction and structure will result from the political processes that determine the rules for the new competitive era.[97]

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(3) "or" pricing at the corporate level using the traditional contract approach. Source: FERC, November 1994, 55036.

[91](1)"enhanced" contract path pricing; (2) flow-based pricing; (3) a MW-mile method; (4) postage-stamp "or" ratemaking at the utility level that is combined with power flow analysis to determine the compensation due to all transmission owners on parallel paths; (5) zonal "or" based pricing;
and (6) short-run marginal cost pricing with transmission prices based on line-by-line losses and opportunity costs caused by power flow constraints. Excerpted from: FERC, November 1994, 55035-55037. The RTGs were granted more latitude because they represent the combined interests of transmission users and owners as well as state authorities, and because regional loop flow problems are more appropriately handled through regional pricing structures. Source: FERC, November 1994, 55036.

[92]FERC, April 1995, 17674.

[93]For example, see: Oren *et al*, 1995.

[94]These zones would need to be defined based upon the composition of individual transmission systems. Their size has yet to be determined.

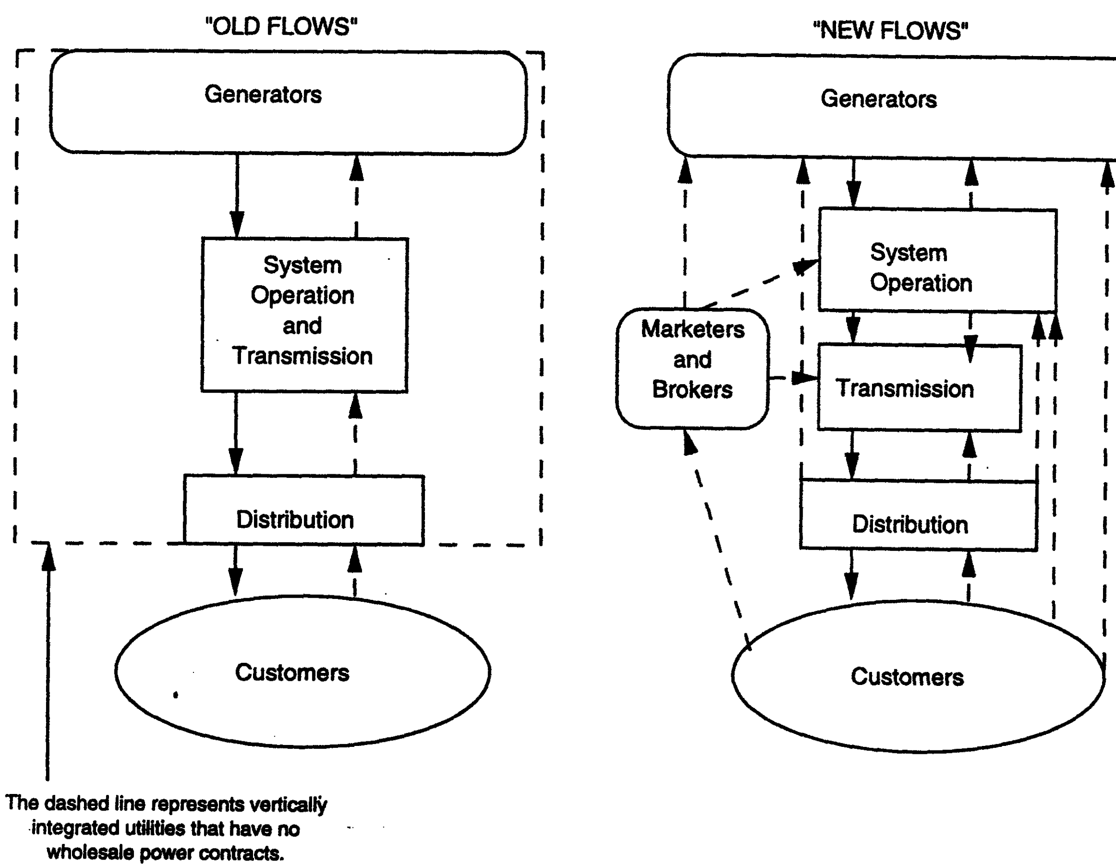
[95]For further discussion in this thesis, see: Appendix J.10 and Chapter 9.

[96]Pierce, 1994, 349.

[97]Dar, 1994. Also see: "Showtime for the Watchdog;" and Holden, November 1995.

The challenge in creating an efficient industry structure is to make appropriate connections between two "parallel universes": the technical operation of electric power systems and the industry's financial workings. While the technical and financial "universes" function separately, they cannot function independently. Decisions in one have implications for the other. In a deregulated industry, the physical flows of electricity and the financial flows of money could be very different (see Figure 3.4), but they should be reconciled in a manner

Figure 3.4 Old and Potential New Flows of Electrons and Money in the Electric Power Industry



Notes: Dashed lines represent financial flows
Solid lines represent physical flows of electrons
Natural monopoly functions are indicated by rectangle boxes
Figure concept: Hirst and Kirby, 1995.

that signals the efficient use of physical and financial resources in the short- and long-run. A further complication is that the physical universe is constrained by existing massive infrastructures which must obey the laws of physics and have generally been technically operated in a laudable manner. Consequently, a restructuring objective should be to reconstitute the industry's financial structures while maintaining (or making few changes to) its enviable physical operation. The task of the remainder of this thesis is to evaluate how efficiently specific deregulation proposals connect these two universes with respect to transmission in the long-term.

Chapter 4[1]
The Internal Responses of Utilities to Competition

Why is an industry which enjoyed stable and effective regulation for over fifty years now moving with lightening speed towards a fundamental restructuring unprecedented in its history? The answer lies in a complex web of historical events and public policy responses -- set against a backdrop of rapid technological change, a seismic shift in the American ideological center, and globalization of the U.S. economy.[2]

-- Peter Navarro (1995)

4.1 INTRODUCTION

The American electric power industry is undergoing rapid and fundamental changes as it evolves from being an industry dominated by vertically-integrated, regulated, monopoly firms to one in which competition plays an important role in at least some of its functions. While there have been some visionaries, the recent changes have come as a surprise to many within the industry. For decades, the electric utility industry was the embodiment of a large, stable industry, where long-term planning ruled, and investors desiring safe returns placed their fortunes.[3] But now, as the industry changes, so too must its firms -- if they are to stay in business. This necessity for utilities to change internally has been evidenced in other deregulated industries, where one-time leaders have lost market share and even gone bankrupt.[4] Entergy Corporation expressed the industry's future well when it stated in its *1993 Annual Report*, "the industry will have winners and losers, champions and fallen giants who lacked the vision to compete."[5] This chapter examines how utilities have responded to the emergence of competition in their industry. It explores questions such as: when did utilities recognize that competition would fundamentally change their industry? Did all utilities recognize it at the same time, or were there some "leaders" and "laggards?"

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[1]Almost all of the content in this chapter comes from a term paper written for the MIT course 6.683 "Operation and Planning of Electric Power," which was instructed by Professors Richard Tabors and Marija Ilic´ during the Fall 1995 academic term. This research was not originally intended to be included in the thesis, however, since it is related to the thesis and adds to the discussion, it was included *ex post*.
[2]Navarro, 1995, 349.
[3]Utility stocks have been described as "Perfect investments for those proverbial widows and orphans." Source: "PG&E: One Step Ahead of Future Shock."
[4]For example, see Gandt, 1995 for the history of the bankruptcy of Pan-Am Airlines.
[5]Entergy, 1993, B.

Once they recognized that competition was coming, did they respond in the same ways? Did some deny it? How did they change internally? Are there ways of measuring these changes? And how have utilities performed according to these measures? Let us begin by examining what the new competitive era will mean to utilities.

4.2 WHAT THE NEW COMPETITIVE ERA MEANS TO UTILITIES

After having lived in a remarkably stable environment for decades, where planning has probably been longer-term in focus than in any other industry, electric utilities now find themselves in a situation where their industry is changing dramatically, quickly, and somewhat unpredictably. The days of the regulated monopoly are numbered -- if they have not already passed -- as the industry moves into a new competitive era. In this new era, the guaranteed rate-of-return from a captive customer base will be no more (at least in some segments of the industry). Instead, utilities will have to compete to keep the customers they have served for decades while they attempt to serve the former customers of neighboring utilities. Instead of being able to pass through the expenses of bad decisions, shareholders will become financially responsible for company mistakes. Utilities will need to keep abreast of new ways to market electricity and attempt to develop new services that create value for customers. Instead of focusing solely on decade-long planning horizons, utilities will need to maintain their long-term perspective while being responsive to rapid industry changes. While living in the past may be more comfortable for those who have grown through the ranks of this generally successful industry, Richard Pierce outlines the stakes of such an approach.

> It is important, however, that utilities recognize the inevitability of the transition for the purposes of their internal decision-making, notwithstanding the predictable vigor with which many will resist the transition. Utilities that reduce their costs rapidly and aggressively and make the many other changes in corporate culture required to participate effectively in a dynamic competitive market will survive the transition and will prosper in the post-transition environment. Utilities that devote all of their resources to resisting the transition, and indulge the tendency to deny the inevitability of the transition, will not be around to participate in the post-transition market.[6]

Although it is fraught with complications and dangers, the new era offers utilities an opportunity for higher returns than they could earn in the old era -- if they operate efficiently and make sound business decisions. Utilities will have the opportunity to expand beyond their relatively small service territories and sell electricity regionally, nationally, and globally.

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[6][6]Pierce, 1994, 349.

This new era, filled with both risks and opportunities, could hardly be more different than the era that is now ending. Yet, the same utilities that have decades of experience in the old era now must compete in the new one. While many core technological competencies will be relevant in both, the new era will require many changes in organizational competencies. In fact, due to the technological complexity of electric power generation and delivery, there are few, if any, "commodity" industries that require as wide of a breadth of organizational competencies as will the emerging competitive electric power industry.

With this as a backdrop, let us next examine how electric utility performance is evaluated.

4.3 UTILITY PERFORMANCE MEASUREMENTS

4.3.1 General Measures

Traditional measurements of utility performance have included both physical and financial measures, such as heat rate, cost per kWh, cost per MW of capacity, employees per customer, and employees per MW of capacity. While these may at first appear to be useful statistics,[7] they do not account for conditions which are beyond the control of management in the short- and even perhaps the long-run. These factors include load diversity, characteristics of installed plant, location, and economic and regulatory conditions.[8]

4.3.2 Financial Ratings Agencies

4.3.2.1 Purposes of Ratings Agencies

As would be expected from their name, investor-owned utilities (IOUs) are financed through private capital. In order to raise this capital, either through stock or bond offerings, IOUs must attract money from investors, who, in turn, want to be informed of the credibility of their potential investments. While the Securities and Exchange Commission (SEC) enforces laws that require publicly-traded companies to provide investors with financial information, investors recognize that this material is prepared by the company who is seeking their money. Although the SEC mandates that companies be honest, investors realize that the information could be tainted with bias, and consequently seek out more impartial analyses. Furthermore, even if company-provided information was completely impartial, most investors do not have the time nor the expertise to carefully evaluate the material. As a result, investment ratings companies have emerged as impartial evaluators to fill the "imperfect information" gap between investors and companies. These

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[7]And they can be, if they are: (1) used for cardinal, not ordinal judgments; and (2) are used in combination, not as a stand-alone criterion.

[8]This list partially comes from Berndt *et al*, 1995, 69.

agencies do extensive research on companies in order to rate potential investments on characteristics such as risk and growth potential.

4.3.2.2 Changing Measures

Historically, when utilities served stable, monopoly markets with a quasi-public service mandate, utility stocks and bonds were sound investments. Issues of primary concern to investors (and therefore ratings agencies) were financial statistics such as debt-to-equity ratios. On the other hand, characteristics like a utility's competitive position in the market were not only unimportant, they were meaningless. However, the changes in the electric power industry have prompted Standard and Poors[9] and Fitch Investors Services to reevaluate their utility performance measures and to incorporate considerations for the new, competitive era. Whereas the old investment criteria were dominated by financial indicators, the new criteria incorporate a utility's competitive position into its investment rating.[10]

Standard and Poors now has two large components that go into its stock and bond rating process: financial position and business position.[11] These are then qualitatively added together to establish a rating. Key points in the business position ranking include:[12]

- Market, service-area economy;
- Competitive position;
- Fuel, power supply;
- Operations;
- Asset concentrations;
- Regulation; and
- Management.

Fitch has switched even more of its emphasis away from the "old" era, by placing financial and competitive considerations into the same framework. The new Fitch criteria, along with their weighting value, are as follows:[13]

- Management (20%)
- Rate competitiveness (20%)
- Financial/legal performance (20%)
- Plant (15%)
- Local regulation (15%)
- Demographics (10%)

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[9]O'Driscoll, October 1993.

[10]Moody's has also changed the focus of its analysis of utilities. "'Instead of the traditional focus on rates of return, construction budgtets, and regulatory activity,' says Moody's, 'analysis is becoming wieghtd towards cash flow, profit margins, and returns on assets as measures of the efficiency of a compay's operations." Source: "Moody's: Customers Keep the Pressure On."

[11]The information in this section comes from: "Rating Investor-Owned Utilities."

[12]For a more in-depth discussion of S&P's new criteria, see: "The Measure of Management."

[13]Forde, 1994, 22-25.

From this discussion it should be clear that historical methods for rating utilities are no longer applicable. Yet the new criteria, while valuable for achieving their purpose of rating utility investments, are not particularly effective at answering the questions that are being asked in this chapter. Nevertheless, some insights can be drawn from them in establishing our own set of criteria.

4.4 PREVIOUS RESEARCH ON THE CHANGING INDUSTRY

While questions regarding the adaptation of utilities to competition have not been asked frequently, they have been asked by some researchers. With that being the case, let us briefly examine what has been discovered.

The importance of competition to utility executives has surged in the past several years. In its annual survey of utility executives, the Washington International Energy Group found that competition was the #7 issue among utility executives in 1992.[14] By 1995 it had risen to the #1 spot on the list.[15]

A 1992 survey of 244 utility executives found that the top four planned responses to competition were (in order): increased attention to customer service, aggressive cost cutting, modifications to long-term strategy, and enhanced management techniques.[16] Of particular interest to researchers has been downsizing. Recent surveys have found that between 64% and 89% of utilities have "downsized."[17] In 1993 alone, almost 17,000 utility employees were laid-off or opted for early retirement.[18] These numbers are borne out when one examines the industry's employment trends. After reaching a peak of nearly 530,000 employees in 1986, the number of people employed in the industry had dropped to only about 466,000 in 1994,[19] while the customer base grew from 77.9 million to 88.4 million. This translates into a jump from a 147 to a 190 customer/employee ratio.[20] While it may not be appropriate to compare individual utilities based upon this statistic alone, such a significant change at the aggregate level is a telling sign that something is afoot in the

[14]Source: "WIEG: Transmission, Competition Key Utility Issues."
[15]Source: "Competition is the Major Concern of Electric Utilities."
[16]Source: "Competition, Regulation Top Utility Concerns."
[17]Source: "Business Bulletin;" "Vanishing Act;" and Doughty and Rode, 24.
[18]Zanotti, 1994, 145.
[19]When one realizes that 17,000 lay-offs occurred in 1993, and downsizing continued in 1994 and 1995, we can imagine that the overall downward employment trend has accelerated in the period since this data was taken.
[20]These statistics come from: "More Customers, Fewer Workers;" and Edison Electric Institute, *Statistical Yearbook of the Electric Utiltiy Industry 1994.*

industry. Yet another survey, this time of 60 utilities and IPPs, found that over 90% had reduced O&M costs and over 70% had undergone reengineering.[21] Another survey reported that 93% of the utilities had enacted some type of restructuring in the past 5 years, with 68% expecting to do so in the next 18 months.[22] In doing so, 40% of the utilities had divided themselves up into strategic business units.[23]

With the research that has been done already in hand, let us embark upon our own study of the industry.

4.5 OUR RESEARCH METHOD

4.5.1 Research Questions and Hypotheses

While a plethora of questions are asked in this chapter's introduction, three primary ones can be pulled from that list:

- When did utilities recognize that competition would fundamentally change their industry?
- How did they change internally in response to this recognition?
- How effective have their responses been?

In conjunction with answering these questions, let us propose two hypotheses:

- The "quick fix" hypothesis -- when utilities recognized the emergence of competition, they first turned to the contemporary "cookbook" management fad; and
- The "early recognizer advantage" hypothesis -- the utilities that recognized competition first are better positioned than those that did not.

4.5.2 Research Sample

These questions are answered and hypotheses are tested through a study of the recent experience of seventeen utilities, which are a subset of the 25 largest IOUs in terms of kilowatt hours sold in 1989.[24] Included in the subset are:

- The ten largest;
- Four of the next 15 that are widely expected to do well in a restructured industry:[25] Pacificorp, Dominion Resource, Northern States Power (NSP), and Union Electric; and
- Three of the next 15 that are widely expected not to fare well: Consolidated Edison, Niagara Mohawk, and Philadelphia Electric (PECO).

In order to answer the questions and test the validity of the hypotheses, our research employs both qualitative and quantitative indicators. Let us first develop the former.

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[21] Doughty and Rode, 24.
[22] Homola *et al.*, 1994, 56.
[23] Ibid.
[24] See Appendix H for a listing of the top 25.
[25] See, for instance: "Another Monopoly Bites the Dust;" "Utilities Go To War;" and Salpukas, 8 August 1994.

4.5.3 Qualitative Analysis Research Method

4.5.3.1 Evaluation Method

The qualitative analysis is performed through an examination of the annual reports of the studied utilities over the period 1989 to 1994, inclusive. To perform this analysis, the researcher reads the opening statements from the chairman and the general discussion sections of the annual reports. In several cases, further reading is done to augment the information contained in these annual reports.

There are several reasons for choosing this method of ascertaining the utilities' response to competition. The first is that the annual report is the forum for a utility's leaders to discuss the situation of the company and promote it to important constituencies: shareholders, potential investors, customers, and employees.[26] Therefore it is a venue for a utility's leaders to discuss those issues that they believe are most important to the company. Secondly, this method provides time-series data. Over time, people forget the exact dates that events occurred, and are even more apt to forget the prevailing attitudes at any given point in time. Reading the annual reports, then, provides for a consistent evaluation of the development of utilities' thinking with regard to competition and adjustments to meet it.

At the same time, though, this method has several weaknesses. The first of these is that the data is self-reported. This brings with it two problems: selectivity and inability to measure implementation. The first and perhaps most obvious problem caused by selectivity is that a utility uses its annual report to "sell" people on the company. Therefore, it will tend to err on the side of a favorable discussion of its position. Beyond that self-serving motive, it must be recognized that an electric utility is a large enterprise with many issues that effect it. An annual report attempts to concisely capture the important issues. Therefore, a utility's executives and public relations personnel must be selective as to what issues will be covered and in what depth. For example, a utility might have made decisions in the late 1980s for a host of reasons, including competitive positioning. However, since a competitive market was years from developing, an annual report may not have cited "preparing for competition" as a decision-making rationale.

Secondly, awareness and executive philosophy does not necessarily equate to implementation. An executive may talk about certain issues, such as "best practices," even though they do not exist in the company. The difference between the rhetoric and reality could be caused by at least three factors: ineffective implementation, lip service, or

[26]Dunk, 1995.

inspiration. In the first case, management is not able to effectively implement its ideas for how the organization should function. In the second, an executive has no commitment to the principles that she expounds. They are just words with little or no intent behind them -- the executive has read several management books and is parroting what she thinks will impress the readers. In the third case, the executive is attempting to prepare constituents for future change and to inspire and reinforce corporate goals. It is a discussion of what he wants the company to become, not what it currently is.

Another problem with this method is that the researcher must interpret the annual reports, which also can cause "errors." For example, concepts that should be read between the lines might be missed, while others are found (between the lines) that were not really there. Errors can also occur in classifying information according to the frameworks on which the utilities are evaluated.

The bottom line is that the qualitative research, while it has some worthwhile qualities, is imperfect. As a result, the results should be examined for general trends, not for accurate or precise conclusions about specific utilities or representative conclusions about the larger industry.

4.5.3.2 Evaluation Criteria

4.5.3.2.1 Recognition of competition

The first question that is asked in this research is: when did utilities recognize that competition would lead to a fundamental change in their industry? It is important to note that this means the recognition that competition will lead to a significant change in their core business, not just that it will occur at the margins.[27] This is observed by reading the annual report and determining whether the utility recognizes that it will face competition in the future. It is assumed that because of the significant changes that would result from competition, corporate executives would appraise their shareholders of the development of competition soon after they recognize that it will occur.[28]

4.5.3.2.2 Management "fad" responses to competition

With the question of recognition out of the way, the next logical question is: how did utilities respond? The research attempts to answer this in several ways. The first is to

[27]This distinction is important, because in several cases in the research there are utilities who had formed affiliated IPPs who were not classified as recognizing competition. They observed opportunities at the margins, but did not appear realize that their core business would eventually be threatened by competition.
[28]It is further likely that securities laws mandate that utility executives inform investors when they recognize something as significant as the coming of competition.

determine the validity of the "quick fix" hypothesis -- did utilities turn to the management fad of the time to bolster their competitive position? One could imagine that when faced with a new challenge (in this case competition) the first choice for many managers would be to follow the contemporary wisdom of fellow managers -- which is embodied in business fads. While this hypothesis may make intuitive sense, the research seeks to determine if it is actually true.

The first management fad that is examined is downsizing. Since the mid-1980s, corporate America has engaged in a long process of cutting back on their workforces, which manifests itself in early retirement offers and lay-offs.[29] With the talk of downsizing constantly in the press, often favorably until recent years, one could imagine that when a utility executive recognizes the emergence of competition, he might opt to downsize. Such an action may be appropriate for many utilities given that utility bureaucracies have been able to grow with few checks in the comfortable existence that the industry lived during the rate-of-return regulatory era. Therefore, some workforce reductions are likely necessary in order for utilities to become competitive in the new era.[30]

The second management fad, total quality management (TQM), stemmed from the rise of the Japanese during the 1980s. When American managers found themselves up against the rising tide of Japanese dominance, they searched for the key to Japanese success. One discovery was that many successful Japanese companies employed total quality control principles. Workers are given unprecedented authority over their work[31] and the ability to make incremental changes in processes that would make their work more efficient and/or lead to higher quality products in "total quality" operations. While TQM is based on continual, incremental changes, the fad that replaced it calls for rapid, radical change.

[29]For an excellent discussion of this phenomenon and its externalities, see: "The Downsizing of America." It should be noted that some or much of this downsizing has served the useful purpose of reducing bureaucratic largesse, in its most pathological extreme, executives engage in these purges as an act of bravado. Downsizing becomes an end, rather than the means to an end.

[30]This is based upon the experience in other industries that have undergone deregulation. The trend is that overall industry employment does not change much, but this because the former monopoly cuts many jobs and new entrants hire about the same number of employees as the old monopoly eliminated. Source: Winston, 1993, 1281.

[31]For example, the ability to stop the assembly line to fix a problem. Such front-line authority was in direct opposition to the mass production philosophy that underpinned much of American manufacturing at that time. For a description of this in the automobile industry, see: Womack *et al*, 1990.

The reenigineering fad was started in Cambridge by a pair of MIT graduates.[32] The basic concept of reengineering is that work systems have evolved over time to meet specific situations, many which no longer exist. As a result, the current organizational structure is not designed rationally.[33] Reengineering seeks to change a company by starting with a "blank slate" organizational chart and a list of tasks that are essential for the firm to create value for the customer. From there, the organization is redesigned so that it most efficiently performs those tasks.

4.5.3.2.3 Best Practice

The third set of qualitative measures is the Best Practice paradigm.[34] This series of measurements attempts to determine which utilities have moved beyond the wonder-cure-all management fad of the era and have made fundamental changes that will result in a long-term competitive firm. These criteria come from the MIT Commission on Industrial Productivity, which noted six characteristics that were common to many of the companies that remained internationally competitive in an era where American manufacturers were "falling behind" those from Japan and Germany. While first developed in the late 1980s, the Best Practice paradigm continues to be relevant in the 1990s.[35] The components of the paradigm are:

- Simultaneous improvement in quality, cost and delivery;
- Staying close to the customer;
- Closer relations with suppliers;
- Using technology for strategic advantage;
- Flatter and less compartmentalized organizations; and
- Innovative human-resource policies.

Let us briefly describe each one of these, in turn.

4.5.3.2.3.1 Simultaneous improvement in quality, cost and delivery

The first best practice quality is simultaneous improvement in quality, cost, and delivery.

While at least one of these features can be found in most companies,

> best practice firms put particular emphasis on *simultaneous* improvements in quality, cost and speed. Other firms have made partial improvements by trading off one dimension of performance against another; only the best companies have made significant improvements in all three.[36]

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[32]Initially launched in a 1990 *Harvard Business Review* piece, it was not until the 1993 release of the book *Reengineering the Corporation* that the concept became a legitimate management fad. Sources: Hammer, 1990; and Champy and Hammer, 1993.

[33]Rationally being defined here as: in a way that will most efficiently perform the organization's tasks.

[34]Dertouzos *et al*, 1989, 117-128.

[35]Bagnall, 1995.

[36]Dertouzos *et al*, 1989, 118.

A further characteristic of best practice firms is "an emphasis on competitive benchmarking: comparing the performance of their products and work processes with those of the world leaders in order to achieve improvement and measure progress."[37]

4.5.3.2.3.2 Staying close to the customer

Best practice firms make a "concerted effort" to develop and maintain close ties to their customers. These ties allow the firms "to pick up more differentiated signals from the market and thus to respond to different segments of demand."[38]

4.5.3.2.3.3 Closer relations with suppliers

The third best practice characteristic, which was common to all of the best practice firms studied by the Commission, is that efforts are made to improve coordination with external suppliers in order to reduce inventories, speed up product flow, and reduce defects.[39] This improved coordination can occur through both coercive power and cooperative negotiation. Regardless of the mechanism, best practice firms find a way of improving their position with suppliers.

4.5.3.2.3.4 Using technology for strategic advantage

Like many others, "best practice" firms utilize new technologies. What differentiates them is that best practice firms do more than just buy the latest and greatest technologies, they "have integrated technology choices into the rest of their business planning, including strategies for manufacturing, marketing, and human resources."[40] In short, technology innovation and use is a means to strategic improvement (however defined), rather than an end.

4.5.3.2.3.5 Flatter and less compartmentalized organizations

The fifth best practice quality is found in the way that these companies organize themselves. The commission found, "In virtually all successful firms ... the trend is toward greater functional integration and fewer layers of hierarchy, both of which promote greater speed in product development and greater responsiveness to changing markets."[41] Best practice firms eliminate layers of management that stifle creativity and impair the companies' ability to react nimbly to changes in the market. In the place of a stifling bureaucracy, empowered cross-functional teams emerge which are charged with tasks such

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[37]Ibid., 119.
[38]Ibid.
[39]Ibid., 121.
[40]Ibid., 121.
[41]Ibid., 122.

as solving problems, developing new products, and manufacturing them. These changes require and reinforce structural changes that lower functional barriers and decentralize authority.

4.5.3.2.3.6 Innovative human resource policies

The sixth quality of best practice firms is that they employ innovative human resource policies.

> Best practice firms have recognized that improvements in quality and flexibility require levels of commitment, responsibility, and knowledge on the part of the work force that cannot be obtained by compulsion or cosmetic improvements in human-resource policies ... The most successful firms recognize that quality is the output of an entire production system, and not the result of an organizational gimmick.[42]

In our evaluation of annual reports, it is sometimes difficult to determine whether a utility made "best practices" a fundamental part of a new way of doing business, or whether these were just shallow gimmicks. At the very least, though, our analysis determines whether such practices were even attempted.

4.5.3.3 Stages of Competitive Development

Another evaluation criteria identifies the progress of the utilities based upon the framework of Gardner and Gilson. In their research of four other industries that underwent deregulation,[43] Timothy P. Gardner and Lawrence D. Gilson provide a framework for the stages that occur as industries move from being dominated by protected monopolies to becoming competitive. This framework, called "The Milestones From Protected Monopoly to Market Competition,"[44] tracks the experiences of six industry players[45] through five stages of development (see Tables 4.1 and 4.2). The players of interest in our analysis (the utilities) would be classified as the "traditional providers." At any given point in time, the plethora of players will be at various stages of development in a given industry.[46] Table 4.3 outlines the framework for the behavior of traditional providers during each of the various stages.

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[42]Ibid., 124.
[43]Airlines, Natural Gas, Railroads, and Telecommunications.
[44]Gardner and Gilson, 1994, 8-9.
[45]Traditional providers, regulators, competitors, customers, financial markets, and employees
[46]Those that are "more developed" are the leaders, and those that are "less developed," the laggards.

Table 4.1: Gardner and Gilson's Stages of Development

- Equilibrium
- Rumblings in the Provinces
- Identity Crisis
- Refocus
- Dynamic Competition

Source: Gardner and Gilson, 1994.

Table 4.2: Gardner and Gilson's Industry Players

- Traditional Providers
- Regulators
- Competitors
- Customers
- Financial Markets
- Employees

Source: Gardner and Gilson, 1994.

Based upon this framework, we place each of the utilities in one of the stages of competitive development in each of the years studied. As a benchmark, we also characterize the stage of progression of the industry -- based upon an estimate of where the "average" of the six categories of industry players were in each year.

4.5.4 Quantitative Analysis Research Method

4.5.4.1 Price Changes

Because those who are leading the efforts to restructure the industry explicitly state that "we are single-minded in [our objective] -- to lower the cost of electric service...,"[47] it seems imperative that this research examine how utilities' rates have changed between 1989 and 1994, as they have been anticipating competition. It should be noted that an inter-utility comparison based solely upon rate levels would not be appropriate for our study because rate levels are influenced by a wide variety of technological, regional, economic, and regulatory factors that are influenced little by the internal workings of the utility in the short-term.[48] As a result, we do not compare the absolute rate level in this measure, but rather, examine the relative change in the utilities' rates. Therefore, the first quantitative measure is to examine the change in the rates of a utility over the period 1989-1994.

[47]California Public Utilities Commission, 1994, 1.

[48]Berndt *et al*, 1995, 69.

Table 4.3: Stages of Development of Traditional Providers

Stage I: Equilibrium

- Vertically integrated full-services provider
- Engineering-driven
- Functional not process organization
- Monopoly franchise growth is objective
- Earnings driven rather than cash flow driven
- Regulator seen as key to financial performance
- Obligation to serve paramount
- Cost-based pricing
- Service reliability & rate base earnings encouraged spending

Stage II: Rumblings in the Provinces

- Continued belief in natural monopoly
- Perceived barriers to entry
    - bundled services (full-service providers)
    - own and build (asset driven)
- Full penetration of traditional markets in monopoly franchise

Stage III: Identity Crisis

- Across-the-board O&M cost cutting
- Defend "at risk" market segments by seeking low cost provider role
- Seek regulatory protection
- Service unbundling
- Invest heavily in technology & new systems
- Defensive pricing
- Reorganize but preserve functional lines
- Establish market function
- "Grass is greener" syndrome (unrelated diversification)
- Effort to "park" windfall cash outside regulatory purview
- Pressure on financial performance: pay out ratios deteriorate

Stage IV: Refocus

- Increasing performance variability; some fail
- Pursue market segments on basis of value
- Service line repackaging
- Process re-engineering
- Advocates fuller deregulation
- Market influenced, regulator-approved prices; prices decline
- Divest unrelated diversification
- Selective diversification in core competencies
- Redefine basic business
- Reorganization to reinforce new business definition
- Asset write downs (including stranded costs)
- Cash reinvest not distributed via dividends
- Eliminate low value activities
- Cash flow driven with reinvestment bias
- Organize by customer segment, product line or process
- New management decision tools fit new needs

Stage V: Dynamic Competition

- Reinforce; grow redefined business via reinvestment, acquisition & divestitures
- Escape commodity trap
- Maximize shareholder value
- Deploy assets dynamically to optimize creation of cash value
- Market pricing
- Consumer protection concerns
- Non-market public concerns
- More winners & losers

Source: Gardner and Gilson, 1993, 8-9.

4.5.4.2 Regional Competitiveness

Although the absolute value of rates is not a perfect measure of how utilities are internally changing, it is still an important. In the new competitive era, customers will not base their decisions on how well a utility is changing its organization, but rather, on the price of the service it provides.[49] Therefore, we also have a quantitative measure that controls for the general price differences across the country, while still measuring the absolute value of a utility's rates. We term this the regional competitiveness ratio (RCR). It is a rather simple statistic: the ratio between the utility's average rate for all customers, divided by the average rate of all customers in the state(s) in which the utility serves. This ratio is weighted to reflect the amount of power that the utility sells in each state. The formula for this ratio is:

$$\text{Regional competitiveness ratio} = \sum_{i=1}^{n} \frac{r_i}{\sum_{i=1}^{n} r_i} \bullet \frac{p_i}{a_i}$$

where:
n = number of states in which utility serves
r_i = the utility's revenue in state i
p_i = the utility's average price in state i
a_i = the average electricity price in state i

The state-level price comparison is one (imperfect) indicator of the future competition that a utility faces. It should be acknowledged that utilities will not just compete with the others in the states that they currently serve. As a result, it could be argued that a more appropriate measure for a Massachusetts utility would be a ratio of its rates compared with those in the New England Power Pool, as opposed to only those in the State of Massachusetts. On the other hand, it is not clear what the geographic limits of competition will be in the new era. It might be that the Massachusetts utility competes only against other producers in the New England Power Pool. However, it may also compete with those in the New York Power Pool, or perhaps even with American Electric Power (from the Midwest) or the Southern Company (from the Deep South). Therefore, due to the uncertainties of future competitive boundaries, and the calculation simplicity of using state numbers, we use this formula in our research.

[49] Although they will likely pay a premium for quality service.

4.5.4.3 Labor Productivity

The other quantitative measure that we examine is labor productivity. One might ask, why is productivity important? The answer is that "in the long run probably nothing is as important for economic welfare as the rate of productivity growth."[50] With this in mind, the intent of the research is to examine how utility productivity, in terms of MWh/employee, changed over the six year period. Once again, this is not intended to compare the utilities based upon absolute values, but rather to examine how their productivity changed over time.

4.6 RESEARCH RESULTS

In the next three sections we discuss some of the major results of the research.[51]

4.6.1 Qualitative Results

4.6.1.1 Recognition of Competition

There were large differences in the "recognition" of competition on the part of utilities. For example, NSP had extensive discussions on competition in its annul reports as early as 1986,[52] while other utilities, such as the Allegheny Power System, did not "recognize" the emergence of competition until after the Energy Policy Act was passed in 1992.[53] Even then, the utility maintained that the old structure was more appropriate than a competitive one and that the latter would lead to the deterioration of power quality, etc.

4.6.1.2 Downsizing/ TQM/ Reengineering

4.6.1.2.1 Downsizing

All but five of the utilities underwent some type of downsizing. Union Electric and Consolidated Edison (Con. Ed.) avoided downsizing through sustained attrition programs. Con. Ed's program started in about 1980 and by 1994 had resulted in a 20% workforce reduction. Union Electric's program started in 1987, and by 1994, the company had eliminated 17% of its positions. It should be noted that all of the dozen companies that downsized did so more than once. An interesting caveat to this downsizing trend is that many of the downsizings of the early 1990s were not caused by the emergence of competition, but rather, by unfavorable public utility commission decisions.[54]

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[50] Baumol *et al*, 1989, 1.

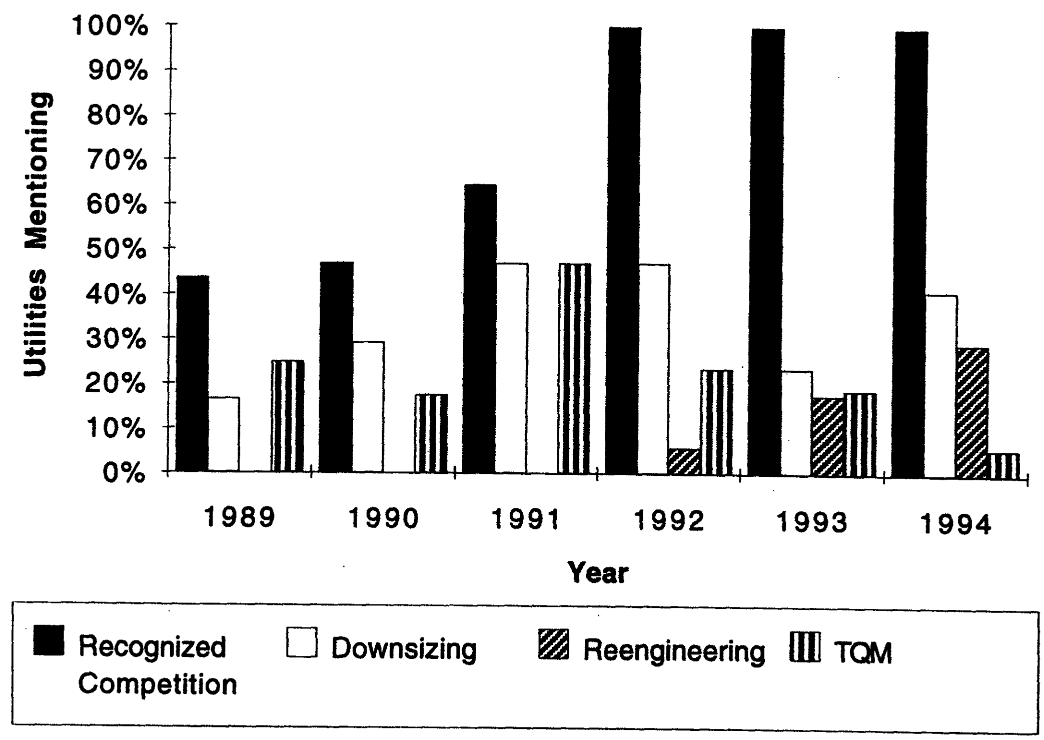
[51] For utility-specific details, refer to the comprehensive qualitative and quantitative results in Appendix H.

[52] Based upon extensive discussion in the 1989 annual report we went through older annual reports in order to find when such discussions began.

[53] Annual reports are issued in the spring of the year following the year of the report. For example, the 1992 Allegheny report would have been published in Spring 1993.

[54] At least five of the utilities had cost recovery for plants disallowed: Philadelphia Electric (Limmerick Nuclear), Texas Utilities (Commanche Peak nuclear), Southern Company, Unicom (Byron Nuclear), and

Figure 4.1: Recognition of Competition, Use of Downsizing, TQM, and Reengineering vs. Time



4.6.1.2.2 Total Quality Management

The use of Total Quality Management by utilities peaked in 1991, when 47% of those sampled reported TQM activities. In 1994, only one utility (Duke Power) still reported TQM activity, and even there, TQM appears to be in decline. In its 1993 report, Duke mentioned that it was planning to start a TQM awards process for its suppliers; but no mention of it was made in the 1994 report, where TQM itself received only passing comment.

There does not appear to be a connection between early recognition of competition and the use of TQM,[55] nor between the use of TQM and preparations for competition. For example, Unicom reported that it was engaged in TQM before it "recognized" the emergence of competition.

American Electric Power (Zinner - coal converted from nuclear). All but the latter were partially or primarily responsible for downsizings.

[55]This is not in keeping with the quick fix hypothesis, since TQM was the management fad during the time period where early recognition of competition occurred.

4.6.1.2.3 Reengineering

Reengineering did not become popular among the utilities until 1994, which is not surprising because it was not until 1993 or 1994 that it became a mainstream management fad. In 1994, 29% of the utilities were engaged in reengineering activities, up from 18% in 1993, and 6% (one utility - Texas Utilities) in 1992. There do not appear to be any connections between those utilities that reengineered and those that were either early or late recognizers of competition. There also does not appear to be any connection between competitive positioning and reengineering. Several of the leaders, such as Duke Power and FPL Group are engaged in reengineering efforts, but so too are PECO and Niagara Mohawk.

4.6.1.3 Best Practice

4.6.1.3.1 General findings

None of the utilities are at the point where they can be described as "best practice" firms. This is a significant finding, in that the set of best practice qualities are mutually reinforcing and form a single, integrated strategy, rather than being "a list from which firms can pick and choose."[56] Therefore, the ideal situation and the synergy that accompanies it does not appear to be present in these utilities. There is reason for hope in the findings, however (at least for those who believe that a best practice organization can develop from a summation of good practices that develop over time).[57] This hope stems from the apparent general trend toward "better practice."[58] Perhaps this trend will eventually lead to the emergence of best practice utilities.

4.6.1.1.2 Most common and least common characteristics

When we examine where the utilities are coming the closest and falling the farthest from the best practice ideal, we find that firms are most likely to be close to customers, and least likely to be close to suppliers. This is not surprising in many ways. Getting close to the customer, at least on the level that utilities would report in an annual report, may be the easiest organizational change to make. The most common method by which utilities reported becoming closer to their customer was for them to consolidate disperse service operations into a centralized 24 hour telephone center,[59] where customers can have any

[56]Dertouzos *et al*, 1989, 118.

[57]See, for example, Rayner, 1992. An opposite viewpoint is that a best practice firm is the result of a deliberate, initial "proper" mindset.

[58]Employing more of the qualities over time.

[59]For the purposes of this research, actions such as opening 24 hour service centers are cause for giving the utility credit for being close to the customer. While this undoubtedly leads to an over-reporting of "best practice," since it is likely that some of these merely fix the specific problems without improving overall

problem solved. One of the unfortunate limitations of this study is that we cannot determine if utilities really get closer to the customers, listen to their needs, and make broader service changes; or whether they are just responding to customer problems, with no feedback loop.

On the other end of the spectrum, utilities do not seem concerned with supplier relations.[60] Part of the reason for this, undoubtedly, is that the largest "supply" is fuel -- a commodity input.[61] Utilities cannot sit down and work with fuel suppliers to get higher quality inputs at better prices or split the responsibility for component design in the same way that an automobile manufacturer can with its suppliers.[62] Two exceptions to the general trend are Texas Utilities and Pacificorp, both of whom have vertically integrated much of their fuel supply.[63] Several other utilities have attempted to "solve" their nuclear supply chain problems by starting their own enrichment plants.[64] Fuel is not the only item that is supplied to utilities, however. It is interesting to note that few of the utilities mention that they work with "suppliers" to develop better components for their systems. When mentioned, technological development of processes is in the context of internal research or demonstration projects with the Electric Power Research Institute (EPRI).

In addition to interesting findings regarding the most common and least common Best Practice characteristics, there are several interesting results with respect to the other criteria.

4.6.1.3.3 Interesting findings with respect to other Best Practice characteristics

4.6.1.3.3.1 Innovative human resource policies

In the research we found two primary strains of innovative human resource policies: incentive pay and training. Incentive pay programs were used by a few utilities as early as 1989 (NSP, Duke Power and Entergy). At that time, these utilities claimed that only five utilities in the nation had incentive pay schemes.[65] The intent of such programs is to tie employee pay with the objectives of the organization.[66]

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service; such actions represent a realization on the part of utilities that customers can no longer be taken for granted.

[60]We make this judgment because supply issues are absent from most of the companies' annual reports.

[61]It should be noted, though, that this may be an incorrect and short-sighted view of fuel supply.

[62]Although beneficial negotiations could probably occur in slightly different terms.

[63]Pacificorp owns coal mines and sites its generators on mine premises. Texas Utilities has natural gas subsidiaries that supply several of its plants.

[64]See: NSP, 1989; Entergy, 1989; Duke Power, 1989.

[65]NSP, 1989.

[66]For an extensive discussion of this, in the context of Duke Power, see: Wilkinson, 1993.

Several utilities have started company-wide training centers, which not only teach directly applicable job skills, but also provide employees with education on topics not directly related to the employees' work. Examples of these are The Southern Company College[67] and Consolidated Edison's "Learning Center."[68]

It is interesting to note, however, that these employee programs have been generally de-emphasized (or eliminated) as industry competition has intensified. For example, Pacific Gas and Electric, Entergy, Duke Power, and Northern States Power -- all of whom described these programs as being important for their competitive advantage in the early years of the study -- made no mention of them in 1994.[69] It is not clear whether these utilities scrapped their programs or whether the programs did not make it through the process of selecting material for the 1994 annual reports. Nevertheless, it seems significant that none of these make reference to their human resource policies as being a strategic advantage in the new era. Ironically, several of the competitive "laggards" -- Consolidated Edison, Commonwealth Edison, and PECO -- <u>started</u> these type of programs within the past several years -- when they recognized the threat of competition. It can be hypothesized from these observations that utilities look to cultivate their human resources soon after they recognize competition, but that this commitment wanes over time. Given the small set of utilities examined here, we can only propose this hypothesis.

4.6.1.3.3.2 Using technology for strategic advantage

Another interesting finding regards the use of technology for strategic advantage. In a confirmation of the importance of the information age, those utilities that use technology for strategic advantage[70] most often utilize information technology. The most significant place where this occurs is at the utility-customer interface, where distributed information technologies can perform a range of interconnected tasks.

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[67]The Southern Company, 1992.

[68]Consolidated Edison, 1992.

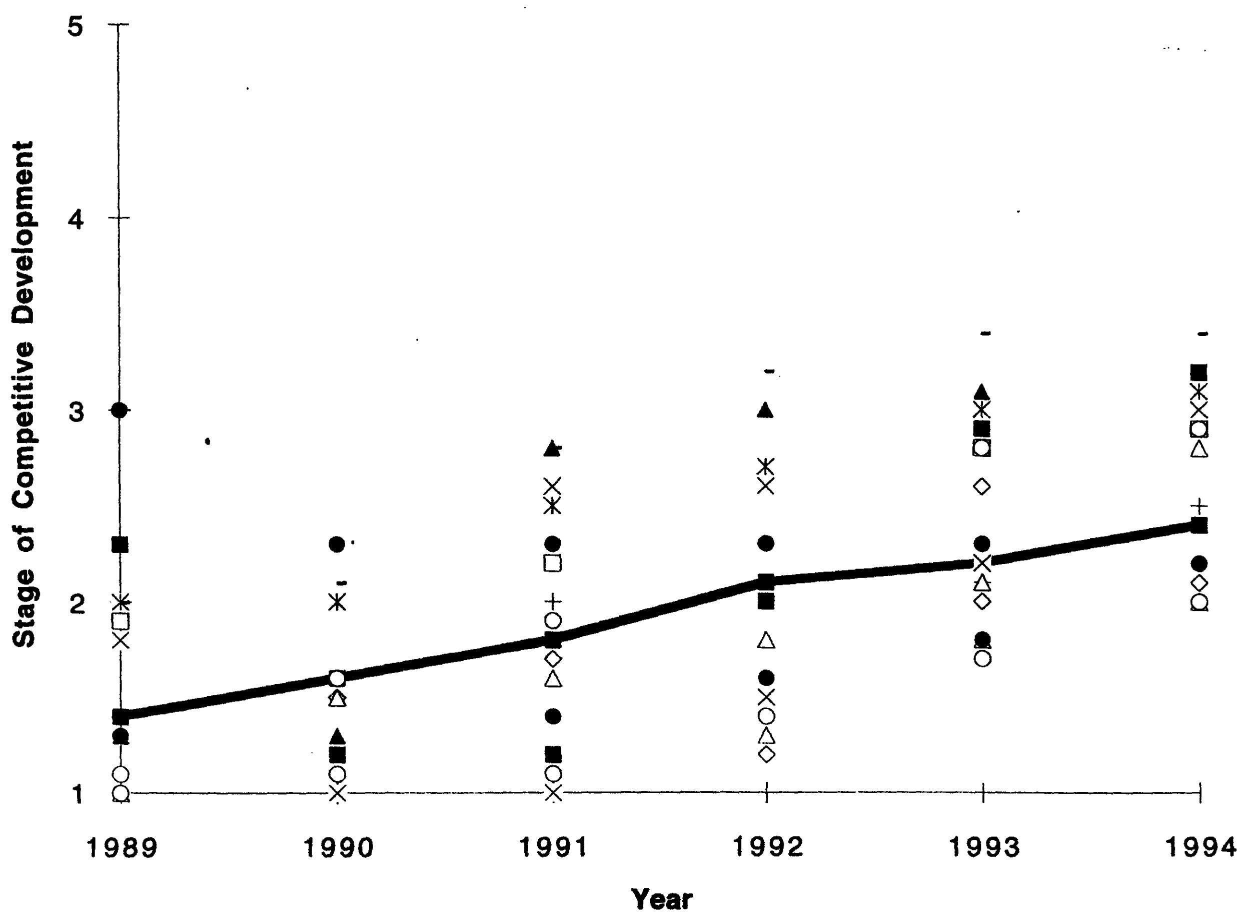
[69]when competition moved to center stage in the industry.

[70]As opposed to those who used it for compliance. In this latter category were many discussions of environmental technologies that did not appear to help the sponsoring utilities' strategic goals. Examples of these are electric cars and some remediation technologies. In the case of electric vehicles, both SCE Corp. and Pacific Gas and Electric devoted the major theme of one of their annual reports to EVs. However, these did not focus on how EVs would help the utility, but rather, what a great, environmental-friendly technology they are.

4.6.1.4 Gardner-Gilson Ratings

In 1994, the utilities in this survey had an average Gardner-Gilson rating of 2.8, with a range from 2.0 (PECO and Unicom) to 3.4 (Entergy). According to their ratings, the utilities are approaching the "identity crisis" category. The industry as a whole[71] had a rating of 2.4 (which places it about halfway between "rumblings in the provinces" and "identity crisis"). Therefore, it would appear that this set of utilities are slightly ahead of the larger industry in the evolutionary process of going from the old era to a new one. Looking at the extremes; Entergy was one of the "leading" utilities on this rating scale in 1989 while both Unicom and PECO had ratings of 1.0 in 1989. It is also interesting to note that all of the utilities moved at least an increment of 0.9, with the exception of NSP, which was well in front of the pack with a 3.0 in 1989 and backslid, before returning to a 3.0 in 1994. This backslide was the result of an unfavorable rate case, which appeared to divert the focus of management for several years.

Figure 4.2: Gardner and Gilson Ratings of Utilities vs. Time



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[71] Which was found through examining the status of all 6 of the industry players.

4.6.2 Quantitative Results

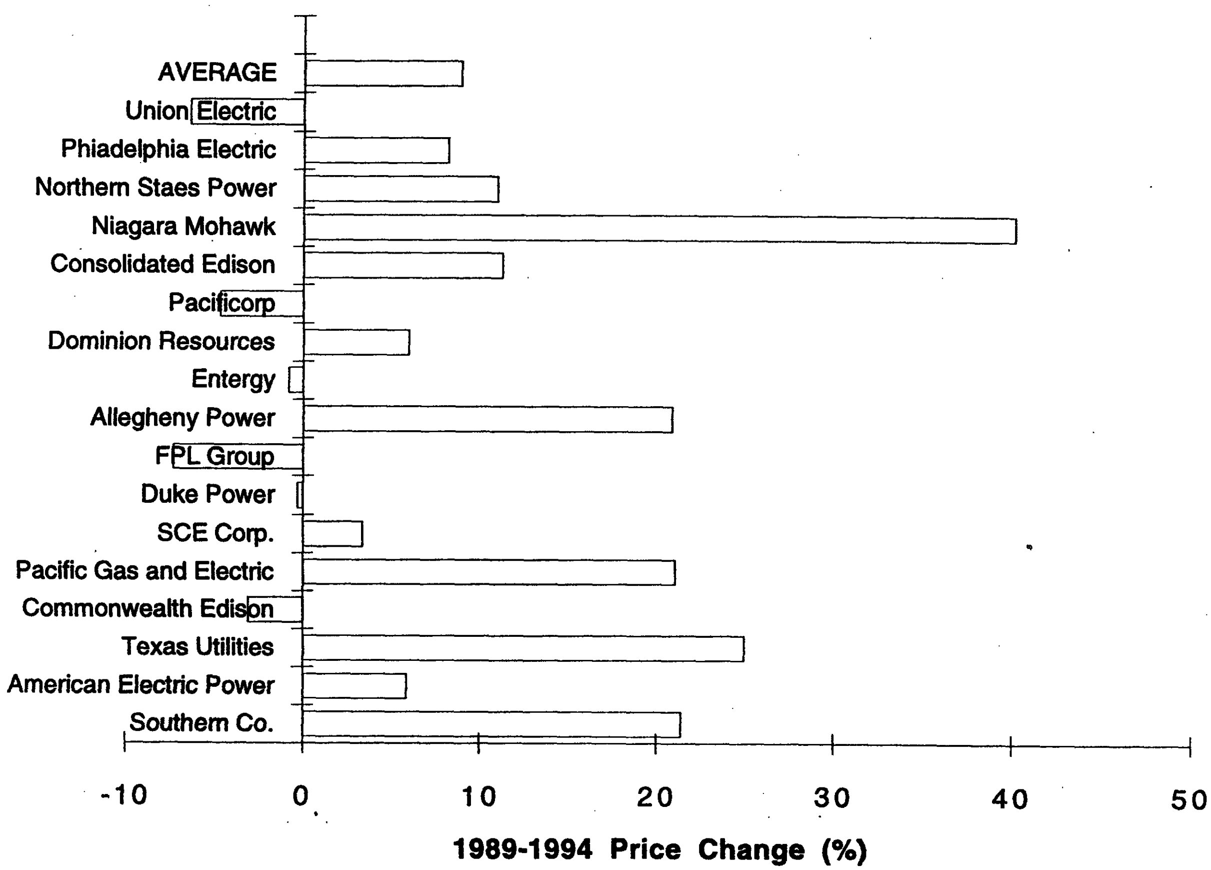
4.6.2.1 Rate Changes

The average rate increase over the period 1989-1994 was 8.9%. In comparison, rates nationally increased 7.1% during that period. This group's figure was inflated by Niagara Mohawk's massive 40% rate increase. In contrast, six utilities had declining rates.

4.6.2.2 Changes in Rate Competitiveness

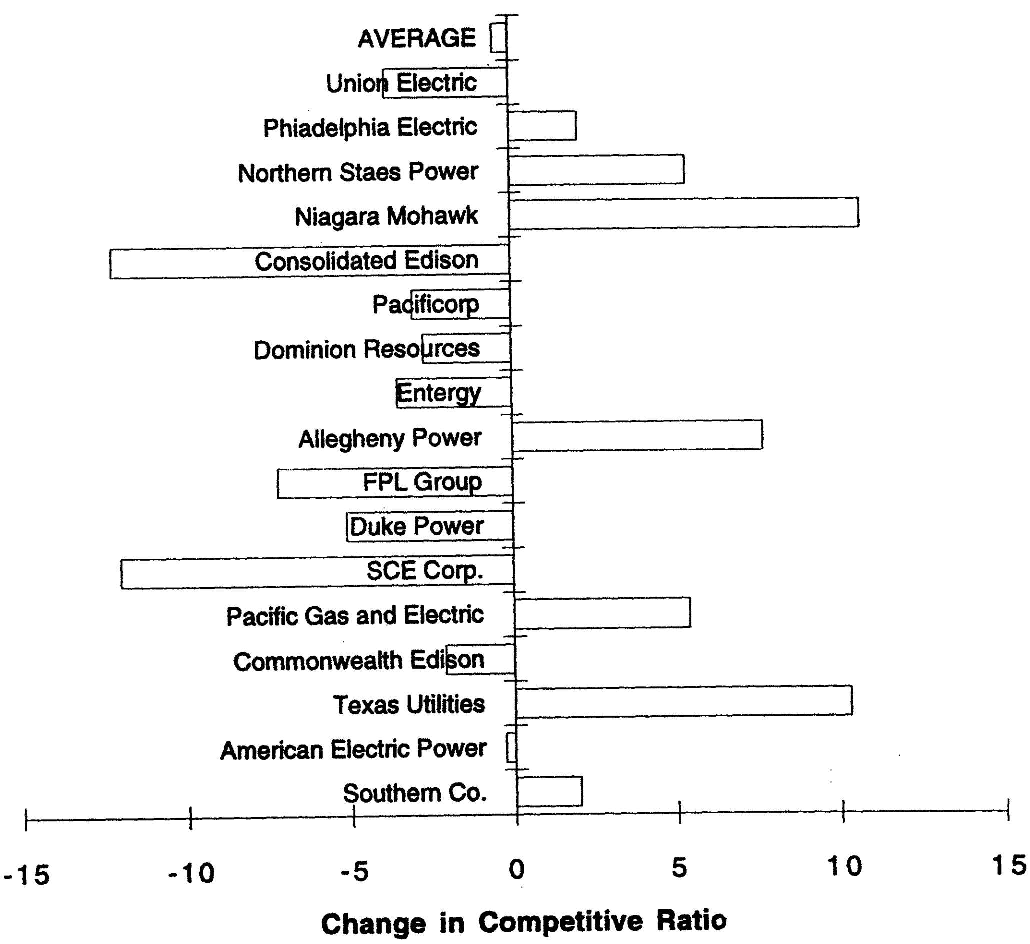
As a whole, these utilities performed slightly better than their peers in terms of becoming competitive in the regions they serve. Overall, the utilities went from having rates that were 100.9% of the average rates in the regions they serve to having rates of 100.5% of the regional average. Individually, ten of the utilities improved their competitive position, while seven of them saw it decrease.

Figure 4.3: Change in Average Electricity Price, 1989-1994



It is interesting that the biggest winner and loser (in terms of rate competitiveness) were from the same state -- New York. Given the method of calculating our statistic, however, this may not be coincidental. The biggest "winner" was Con. Ed., whose change in RCR was a -12.2, despite the fact that it had a rate increase of 11.3% (the sixth highest of the 17 utilities). A reasonable explanation for this is that its cross-state rival, Niagara Mohawk, raised its rates 40%. Such a massive increase by Niagara Mohawk, the second largest IOU in New York, did much to raise the overall average state rate, therefore putting Con Ed in a much more favorable position.[72] Other than Con. Ed.'s success with its long-term work force attrition program, there is no compelling reason to explain why the utility's performance would have been so impressive -- except for the troubles of Niagara Mohawk and the Long Island Lighting Company.[73]

Figure 4.4: Change in Regional Competitiveness Ratio, 1989-1994



[72]Even if Con Ed did little to deserve it.

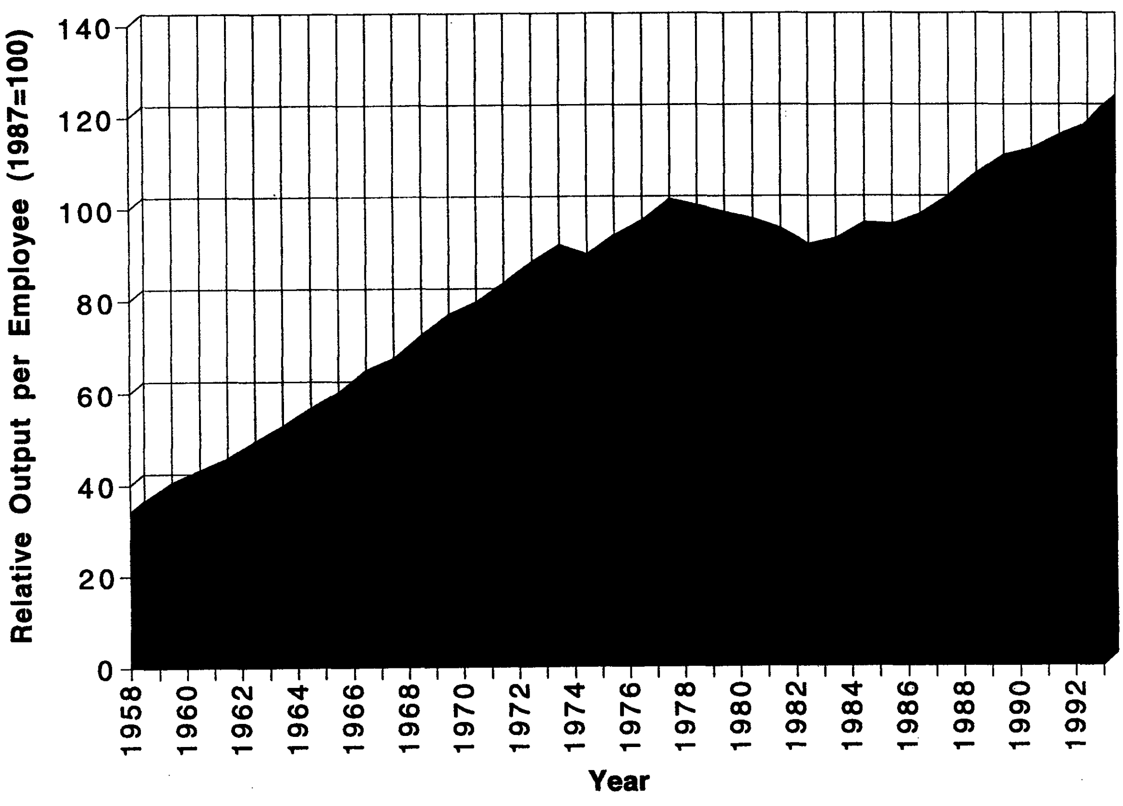
[73]The latter is currently on the verge of being taken over by the State of New York due to significant financial problems -- most notably, it has the highest electric rates in the Continental U.S. One of the main contributors to these extraordinary rates is the agreement that former Governor Mario Cuomo made with the company that kept it from opening its Shoreham Nuclear Plant. Using the old regulatory compact structure, Cuomo was able to advance his anti-nuclear agenda by mothballing the plant soon before it was to open. For a more complete discussion of the utility's troubles, see: Studness, 1996.

With an RCR increase of 10.7, Niagara Mohawk was the largest competitiveness "loser." It was followed by Texas Utilities, which experienced a 10.3 competitive ratio rise. Construction cost overruns from the Commanche Peak 1 and 2 nuclear power plants were largely responsible for the poor performance of Texas Utilities.[74]

4.6.2.3 Employment Productivity

The original intent of this research was to also examine the changes in employee productivity (in terms of MWh per employee) at the firm level. However, the author could not find utility employment statistics that only included those employees engaged in the production of electric power (as opposed to employees of natural gas or other affiliated ventures of the utility). Therefore, these statistics are not presented in this paper. However, industry-wide statistics on productivity are kept by the Bureau of Labor Statistics. As can be seen in Figure 4.5, significant improvements in the productivity of employees have been measured on the cumulative industry level over the past several years.

Figure 4.5: Relative Productivity of Electric Utility Employees



Source: Bureau of Labor Statistics, 1985 and 1995.

[74]Which had large overruns.

4.6.3 Other Results

There are three common themes that run through many of the annual reports that were not measured, but were interesting to observe.

4.6.3.1 Holding Company Formation

One common trend was the formation of holding companies. These structures, which fell into disfavor during the Great Depression, are making a resurgence. Firms such as Virginia Power (Dominion Resources) and Florida Power and Light (FPL Group) were pioneers in this movement. They have been followed by Philadelphia Electric (PECO) and Commonwealth Edison (Unicom). Even more holding companies, both in our sample of utilities and in the larger industry, were created during 1995.[75]

4.6.3.2 Diversification

A recent *EPRI Journal* article[76] reported a dramatic increase in utility diversification activity in recent years. This trend was also evident in the utilities studied in this research. The most common type of diversification was that which occurs in industries related to electric utility core competencies. Most common of all was diversification into the non-utility generation market.[77] Many utilities explicitly stated that they would not diversify into industries not related to their core competencies. This is in sharp contrast[78] to utility diversification efforts of the 1980s, which often proved to be unsuccessful, if not disastrous. An example of this was FPL Corp., which had entered industries ranging from insurance to Cable TV. For most of the period 1989-1994, FPL was looking for buyers for these unprofitable units.

4.6.3.3 Environmental Consciousness

Perhaps the most common topic[79] in the annual reports was a discussion of utilities' commitment to a clean environment. This environmentalism was expressed in many ways, ranging from reports dedicated to the environment,[80] to extensive discussions of environmentally-friendly technological development,[81] to discussions of new corporate environmental policies.[82] One exception to this environmental-friendliness was the open

[75]Source: "Inside Utility Mergers: Trends Within the Trend," 60.
[76]Lamarre, 1995.
[77]Those which have non-utility generation affiliates include: Southern California Edison, Pacific Gas and Electric, The Southern Company, Northern States Power, Dominion Resources, Duke Power, and Entergy.
[78]And is perhaps mentioned so frequently as a backlash to.
[79]Aside from the mandatory financial discussions.
[80]Pacific Gas and Electric, 1990.
[81]SCE Corp., 1990.
[82]The Southern Company.

hostility expressed by the Allegheny Power System toward the passage of the Clean Air Act Amendments of 1990, which required the System to install expensive scrubbers on several of its plants.[83]

4.7 DISCUSSION OF RESULTS

4.7.1 The "Quick Fix" Hypothesis

One of the hypotheses of this research is the "quick fix" hypothesis.[84] The evidence in this study does not support this hypothesis, however. In examining the data in Appendix H, it is clear that there was no correlation whatsoever between a utility recognizing competition and turning to TQM, reengineering, or downsizing. In fact, utilities were *less* likely to employ these management practices during the year that they recognized competition. Instead, the utilities appeared to be deliberate about how they would prepare for the competitive environment. While this might suggest management paralysis, it also could be explained as a continuation of the industry practice of slow, calculated, long-term decision-making. In fact, in the year that they recognized competition, several of the utilities mentioned that they were forming a committee to investigate the implications of competition and would probably have a plan put together by the next annual report.

The utilities studied in this research turned to TQM and reengineering at about the same time that the larger business community did. Among these utilities, TQM reached its peak in 1991, when eight of the 17 utilities said that they were engaged in TQM activities. In comparing this with the larger business community, one barometer of the overall TQM movement would be the number of applicants for the Baldridge Award. In 1991, the Commerce Department received 106 applications for the award, which marked its high-water mark.[85] Among the utilities, reengineering peaked (or was still rising) in 1994, which would be in keeping with the perceived trend in corporate America.

[83] While the scrubber option was expensive, the other alternative -- to buy cleaner coal -- would have been more expensive. This is because the System gets its coal from its service territory. However, it would have to purchase "clean coal" outside of its service territory, an action which would have significant economic consequences on the region it serves, and in turn, on the company.

[84] This hypothesis is: "when utilities recognized the emergence of competition, they first turned to the contemporary 'cookbook' management fad."

[85] Source: National Institute of Standards, 1995. In 1995, only 47 companies applied for the Baldridge.

4.7.2 The "First Recognizer" Hypothesis

The data does not appear to strongly affirm the "first recognizer" hypothesis.[86] The seven utilities that recognized competition in 1989 did tend to do well in the Gardner-Gilson ratings, with six of them having scores above the average of 2.8 in 1994. However, when the focus changes to their quantitative rate competitiveness, only four saw their RCR improve, while three saw it worsen between 1989 and 1994. Although early recognition may not have led to overwhelming success, it also did not lead to significant deterioration of competitiveness. The most egregious examples of worsened competitive position occurred among those utilities that did not recognize competition early. From this discussion it would appear that recognizing competition early can be slightly beneficial, but does not *necessarily* lead to a utility having a better competitive position in the future.

4.7.3 Downsizing as the Only Consistent Response

One obvious observation is that the utilities were quite heterogeneous in their response to competition -- in when they recognized it, how they responded to it, and how well-positioned they find themselves now. The only clear trend in the data this is observed is that utilities have generally turned to downsizing as they position themselves for competition.

4.7.4 Commitment to Employees

The "old" electric utility typified the old American labor "social contract" -- lifetime employment was not guaranteed, but companies took care of their employees and lifetime employment had become an implicit agreement of sort. We find that most electric utilities turned to downsizing as a partial solution to their competitiveness problem (as have many American companies), and that downsizing activity has increased in the past several years. It is interesting to compare this trend with the finding that a number of the utilities that were the early recognizers of competition had innovative human resource policies in 1989 and later de-emphasized (or jettisoned) them, while many of the laggards[87] turned to innovate human resources policies when they recognized competition. Might it be that as utilities become more focused on cost control, they begin to lose sight of their human resources? While this is difficult to prove based upon a small sample and limited information, it is an interesting question that would be worthy of further research.

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[86] This hypothesis states: "the utilities that recognized competition first are better positioned than those that did not."

[87] With respect to recognition of competition.

4.7.5 Organizational Change is Not the Only Factor for Success

While this paper has focused on utilities and the internal changes that they have made in order to become more competitive, it must be recognized that their ability to compete in the future is only partially a function of the internal changes that they make. In this high fixed-cost industry, regulatory decisions and past capital expenditures will play a large role in the ability of utilities to compete.

Some firms, such as Union Electric, Pacificorp, and Dominion Resources are well-positioned, not necessarily because they recognized or explicitly prepared for the coming competitive environment,[88] but because they are low-cost suppliers. While this is a result of good past decisions, it is not necessarily a reflection of preparation for competition.

On the other hand, some utilities are haunted by past decisions, and regardless of how hard they might work to improve their internal workings, they will have a difficult time competing. For example, Niagara Mohawk, which has recently become more competitively focused (although it was a late recognizer) faces serious problems that could overwhelm any internal adjustments it makes to competition. In particular, the utility has been forced to buy power from a myriad of PURPA plants at "avoided cost" rates -- which have proved to be very favorable to the IPPs. By the end of 1995, 2400 MW of non-utility generated capacity was supplying Niagara Mohawk.[89] The result is that in 1994, the utility paid 28% of its revenues to IPPs (approximately $1 billion),[90] which is about $400 million above the current market value for that power.[91] In the old era, the utility could pass these costs along to consumers. However, in the new era, these high-cost obligations could cripple the company (and others in similar situations).

4.8 CONCLUSIONS

During the past six years, as competitive forces have begun their invasion of the electric power industry, the utilities studied in this research recognized and responded to this occurrence in heterogeneous ways. In 1989, less than half of the utilities recognized that competition would lead to fundamental changes in their industry, but by 1992, all of them

[88] Note that Pacificorp and Union Electric received 1.0's for their competitive situation as recently as 1990. Dominion Resources, on the other hand, was one of the very first to recognize and embrace the potential for competition. Although it too appeared to lose sight of competition for a year or two around 1990. See: Berry, 1995.

[89] Niagara Mohawk, 1994.

[90] Ibid..

[91] Source: "New York Utility Seeks Sweeping Changes," 39.

recognized this. This relatively rapid change in perception is indicative of how quickly the move to deregulation has occurred.

The one common response to competition has been downsizing, which was performed by 12 of the 17 utilities. A significant number of the utilities dabbled in other management fads, such as TQM and reengineering, but did not do so as an immediate response to recognizing competition. None of the utilities has thus far been able to get beyond piecemeal solutions and transform itself into a "best practice" organization, although the utilities are employing more of the best practice qualities over time. A number of the utilities instituted innovative human resource programs; however, these programs appear to be de-emphasized as utilities become more competitively focused.

Those utilities which recognized competition first have been at an advantage in terms of being further along in their internal transformation from monopoly providers to competitors and in being able to avoid blunders that have significant detrimental impacts on their ability to compete. On the other hand, these "early recognizer" utilities, as a group, have not used their farsightedness to solidify price advantages vis-a-vis their future regional competitors.

Between 1989 and 1994, the sampled utilities made meaningful progress in recognizing and adjusting to their changing industry. With one exception, the utilities moved more than 0.9 point on the Gardner-Gilson framework, which means that they have essentially moved through at least one stage of organizational competitive maturation.

While utilities can do much to control their destiny through internal changes, they are not in total control of their future -- both regulators and past decisions will have a significant impact on their fate in the new era. Decisions of the past, especially in terms of plant construction, can leave utilities in the position of being inherently low-cost or high-cost suppliers. Furthermore, although the restructuring of the industry is intended to reduce regulation, it will not eliminate regulation altogether. Regulators will still play an important role in the new competitive era, which Vietor would describe as an era of "regulated competition."[92] In regulators' attempts to create new competitive markets without relinquishing full control to market forces, Vietor argues that firms face asymmetries of risk and earnings.[93] In the electric power case in particular, the rules set by regulators for the future competitive marketplace will determine whether utilities get to "play the game" with

[92]Vietor, 1994, 330.
[93]Ibid.

both hands free, or whether they will be expected to perform social functions (such as buy power at subsidized rates) from which their competitors will be exempt, or will even benefit. While a utility's internal functioning, as studied in this chapter, will be important in the new era -- it will likely determine whether a utility will stay in business -- it is not the only factor that will have a significant impact on the future viability of the enterprise. As a result, internal reorganizations must be done in the context of the constraints of a particular utility.

Now that we have gained an understanding of the relevant technologies and historical developments in the industry and recent developments in it, let us explore the deregulation proposals that are currently being developed and debated across the United States.

Chapter 5
Proposals for Deregulation

> *It must be remembered that there is nothing more difficult to plan, more doubtful of success, more dangerous to manage, than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old institutions and merely lukewarm defenders in those who would gain by the new ones.*[1]
>
> -- *Niccolo Machiavelli (1506)*

5.1 INTRODUCTION

The electric power industry restructuring now underway in the United States is part of a growing international trend toward deregulating electric power systems. In other countries, deregulation has meant subjecting a limited number of (often government-owned) companies to new rules promulgated by a central government body. In comparison, the American process of deregulation is awkward indeed.[2] From Massachusetts to California, states are taking different paths as they partially deregulate their electric power industries. These differences are attributable to a number of factors, including the particular individuals with responsibility for the process, the motivations for deregulation, and the characteristics of the utilities that serve each state.[3] State-level deregulation proposals must meet the constraints of the Federal Energy Regulatory Commission's (FERC)[4] oversight of the transmission system,[5] whose design the FERC is currently attempting to develop. This chapter describes the events that have been occurring in some of the states leading the deregulation process and at the national level at FERC. This chapter will explore a number of proposals in some detail, and from these, select five that will be evaluated for their long-

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[1]Gilbert, 1965, 26 (excerpted from Chapter 6 of *The Prince*); and "A Prince of a Quote."

[2]Peter Navarro comments on this and proposes a national policy to mitigate what he views as harmful effects from the situation. Source: Navarro, 1996.

[3]Source: "Despite California's Lead, Many States Shy Away From Taking Competitive Plunge." A late 1994 survey of state commissioners found that 15 of the 36 commissions interviewed described their stance as "negative" or "strongly negative" toward retail wheeling. Source: "Regulatory Outlook Toward Retail Wheeling."

[4]Which has regulatory authority over transmission assets in all of the "Lower 48" states except for Texas.

[5]In order to rationalize this process, Sen. J. Bennett Johnston, a key crafter of the Energy Policy Act of 1992, introduced a comprehensive bill to restructure the electric power industry in early 1996. Source: "Johnston to Offer Restructure Bill, with Retail Wheeling." For a summary of this and other legislative actions, see: "Power Pundits make Their Pitches." By late February 1996, it appeared that these would not be given serious consideration for passage. Source: "Senate Staff: No Restructuring Law in '96."

term economic efficiency in Chapter 10. First, however, we briefly examine the experiences of four countries that have already restructured their electric power industries.

5.2 OTHER COUNTRIES

Just as in Chapter 6, where we seek to learn lessons from the deregulation experiences of other industries in the American context, here we attempt to learn from countries[6] that have already deregulated their electric power industries. As William Hogan has pointed out, "The United States has an enormous advantage in this process because we have the luxury of not being the first to try such a restructuring."[7]

5.2.1 Chile[8]

The first nation to partially deregulate its electric power industry was Chile, which began its process in 1978, during the dictatorial rule of General Augusto Pinochet. Prior to 1978, electricity rates were set through a politicized government process (rather than being based upon sound economic principles). Today, generation prices are set largely through a market mechanism,[9] while transmission and distribution prices remain regulated. Transmission pricing is based upon nodal prices, and distribution pricing is based upon a simple formula that includes: administrative costs, energy losses, and the price of peak-load power. As such, distribution price regulation is a form of performance-based ratemaking (PBR).[10] There is no prohibition on entry into the transmission market and should a new provider build a transmission line, interconnection to the system would be required. As a result, should insufficient transmission capacity exist, new entrants could build transmission lines. The transmission grid operates on an open access basis, although the transmission company is granted some discretion on terms and rates.

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[6]Several other countries (not mentioned in this section), including Argentina, Australia, Peru, and Sweden have also partially deregulated their industries or are presently going through that process. For a helpful table of activity in other countries, see: Flavin and Lenssen, 1994, 1037.

[7]Hogan, November 1995, 51.

[8]Information for this section, unless noted otherwise, comes from: Spiller, 1993; Rudnick, 1994; and Bernstein, 1988.

[9]Wholesale rates and those for large customers (greater than 2 MW) are based upon market pricing, while those for smaller customers are based upon long-run marginal cost pricing principles.

[10]Performance-based ratemaking/regulation (PBR) mechanisms "provide utilities with a fixed price or fixed level of revenues, as opposed to a predetermined level of profits [which occurs in rate-of-return regulation]. As a result, utilities can earn higher or lower profits depending upon how efficiently they plan for and operate their systems. PBR is more market-based than traditional regulation because utilities' decisions are motivated by opportunities to increase profits. At the same time, PBR can ... be designed to encourage utilities to achieve some of the traditional regulatory objectives such as promoting safe, reliable, least-cost electricity, and ensuring that customers are treated equitably." Source: Woolf and Michaels, 1995, 65. Performance (financial) incentives are developed by regulators in order to promote the latter goals.

Since 1978 ownership of the Chilean system has grown from two publicly-owned, integrated companies to eleven generating, 21 distribution, and two integrated firms, many of which are private.[11] This ownership diversity was achieved partially by divestment of assets of the original two companies and partially by the creation of new ones. Today the industry is thriving and is being flooded by foreign investment -- as many as eight new plants may be built in the next decade by foreign investors.[12] Being the first country to experience deregulation, Chile experienced its share of real-time learning. Lessons have included the necessity of having:[13]

- Formal rules, rather than inter-party agreements on basic transmission issues, such as access;
- Mandatory separation of regulated functions and a clear delineation of the limits of involvement by regulated firms in competitive markets;
- Unbundled transmission charges and comparable fair transmission access
- Clearly defined, publish transmission prices which reflect incremental operating and upgrade costs;
- Spot markets and a parallel bilateral market based on long-term contracts; and
- Direct access by generators to at least part of the retail market.

5.2.2 New Zealand[14]

The New Zealand electric power industry started down a path toward deregulation in 1987, when the Ministry of Energy's Electricity Division was corporatized as the Electric Corporation of New Zealand. This entity still generates the vast majority of power in New Zealand (over 90%), even though the generation market has been deregulated. Emerging competition is coming from small independent generating stations. The country's transmission assets are operated by the government-owned Trans Power New Zealand Limited. In running the grid, Trans Power must comply with three public policy objectives:

- to provide non-discriminatory access to transmission,
- to promote efficient use of energy resources through pricing and contracting practices, and
- to provide information that leads to efficient investment.[15]

Trans Power has been regulated through rate of return regulation that has included demand charges, transmission network charges, and energy-related charges. Attempts are being made now to create a competitive wholesale power market. Nodal pricing and congestion contracts are two transmission pricing mechanisms that are being considered for making

[11] The two integrated firms were privatized.

[12] Source: "Chilean Utility Stocks Falling on Fears Rivals From U.S. Will Saturate Market."

[13] These come from: Rudnick, 1994, 12; and Lalor and Garcia, 1996, 64.

[14] Information for this section comes from: Moy, 1994; Lambert, 1991, and Cocklin, 1993.

[15] Moy, 1994, 11.

this market efficient. Such reforms would follow on the heels of progressive deregulation in the distribution sector, which was dominated by 52 publicly-owned electric supply associations. Ownership of these entities has been corporatized and a financial separation has been created between the distribution and retailing functions of these entities.

To the extent that New Zealand continues to reform its industry ahead of the United States, lessons can be learned from its experiences with nodal pricing, congestion contracts, and competition in distribution. While these lessons may not be learned in time for the industry restructuring decisions that are being made in American states at the cutting edge of deregulation, they should provide valuable experience to the next group of states.[16]

5.2.3 Norway[17]

Norway has deregulated its electric power industry to a larger extent than any other country. Since 1992, both the generation and the electricity sales[18] segments of the industry have been deregulated, while a national grid company and 200 local transmission & distribution companies operate as regulated entities. Currently, four types of market transactions occur: bilateral agreements, futures contracts, spot market purchases, and instant market purchases. Rates have fallen significantly since the restructuring has occurred, but this has been in part due to excess capacity and favorable (for consumers) weather patterns. Because of limited availability of English-language documents and the unique character of the Norwegian industry (99%+ of generation comes from hydroelectric plants) we will not examine the Norwegian system any further. Nevertheless, the extent to which it has been deregulated leads to it being used as a reference point in American deregulation debates.

5.2.4 United Kingdom

Probably the best-known electric power industry restructuring happened in the United Kingdom when, on 1 April 1990, the government-owned power industry was broken up into two major privatized generating companies,[19] one privatized transmission system (National Grid Company), and twelve private regional distribution companies. Under this

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[16]This is important because it will not be until the year 1999 or 2000 that lessons will be able to be learned from the actual restructuring experiences of California, Massachusetts, etc.

[17]This discussion is based upon: York, 1994; and Moen and Hamrin, 1996.

[18]Electricity sales was split from distribution service.

[19]Ownership of the country's nuclear plants was retained by the government, in the form of the Nuclear Power Company, which is scheduled to be privatized in the near future. For market power implications of this see: Newberry, 1995, 61-65.

new ownership structure, a pool-based model for the industry was implemented. Each generating station submits a bid for power production for the next day (theoretically, its marginal production cost) to the pool operator (National Grid Company), which then ranks them from the lowest cost to highest. Based upon half-hourly demand projections, the pool operator uses this "merit order" list to dispatch the generating plants. The result is a *de facto* half-hourly auction for power supply. The bid of the highest cost generator that is needed to fulfill demand in a given half-hour sets the system marginal cost. There are several upward corrections then made to this system marginal cost in order to provide for reactive power and spinning reserves, that are based in part on the system's loss of load probability.[20] In terms of Equations 2.8 and 2.9, all generators that produce power during a given half-hour are paid:

$$p_{Gi} = \gamma(t). \qquad \text{(Equation 5.1)}$$

Customers pay the pool a higher price:

$$p_P = \gamma(t) + \eta_{QS,K}(t) + \gamma_R(t), \qquad \text{(Equation 5.2)}$$

which corrects for transmission constraints and ancillary services.

The two private generation companies (National Power and PowerGen) have been immensely profitable in the new market structure,[21] largely as a result of having what is essentially a duopoly[22] submitting bids, which, according to critics and the industry's chief regulator,[23] has allowed them to game the pool price. Since the electric companies were privatized, their stocks have risen 130% above the British all-share index,[24] while electricity prices have also risen.[25] The past year has seen a rapid in crease in merger activity, as British and American firms have bid at least £13 billion ($20.6 billion) for seven of the 12 British distribution utilities.[26] Part of the reason for the acquisition frenzy has been the massive downsizings that have occurred: some companies have laid off up to one third of their workers and are expected to continue cutting costs significantly.[27]

[20]For more specific details on the pool system see: Armstrong *et al*, 1994, 295-297; and Green, 1994.
[21]Tabors, 19 October 1995.
[22]At the time of privatization, together they controlled about 75% of generating capacity. Source: Chou, 1995.
[23]Source: "Electricity Volte-Face."
[24]Ibid.
[25]Source: "The Watchdog that Didn't Bark." One study has found that "residential electricity prices were 25% higher and industrial prices were 19% higher than would be expected based on pre-privatization trends." Cited in Navarro, 1995, 359.
[26]Sources: "CSW Bids $2.53 Billion for U.K. Utility;" "In U.K. Electricity-Concern Takeovers, Up to $31.72 Billion May Change Hands;" and "U.K. Utilities Generate Takeover Frenzy; Last Bid PowerGen's for Midland Faces Hurdles."
[27]Source: "Job Cuts Fuel U.K. Profits." These cuts come on top of previous ones. Between 1991 and 1994, the industry as a whole shed 19% of its workforce. Source: "Shocking Success," 66.

Recently, the two largest generators have agreed to divest themselves of some of their capacity in order to allow for a more fair market.

Probably the most important lesson from the British experience is that horizontal market power in generation is an important issue in creating a competitive industry. The consequence of not eliminating market power has been that "investors and predators are being drawn to Britain's electricity sector by weak regulation rather than dynamic competition,"[28] while customers have experienced little or no gain from the new industry structure.[29]

Having examined the restructuring that has occurred in other countries, let us now examine some deregulation processes that are taking place across the United States, beginning with the leader of the pack -- California.

5.3 PROPOSALS IN CALIFORNIA

Faced with electric power rates well above the national average and an economy reeling in the wake of the post-Cold War trimming of the defense industry, the California Public Utility Commission (CPUC) sought to take action to make the state more competitive by

Table 5.1: Average Electricity Rates for All Customers, By State (1993)

State	Rate (¢/kWh)
Washington	3.72
Wisconsin	5.52
U.S. Average	6.93
Michigan	7.21
California	9.76
Massachusetts	10.04
Rhode Island	10.39
New Hampshire	10.68

Source: Edison Electric Institute, 1993, 75.

lowering its electricity rates.[30] The CPUC's first step was to commission an extensive study of the industry, which became the "yellow book"[31] -- *California's Electric Services Industry: Perspectives on the Past, Strategies for the Future*[32] -- a 200 page discussion of

[28]Source: "Shocking Success," 66.
[29]Tabors, 19 October 1995.
[30]Dasovich *et al*, 1993, 116-118.
[31]So named because of the color of its cover.
[32]Dasovich *et al*, 1993.

crucial issues and the history of the industry. Armed with this information and input gathered during a series of public hearings, the CPUC developed its radical vision for the future of California's electric power industry, which it unveiled in April 1994 in its "Blue Book" orders.[33]

5.3.1 Original "Blue Book" Proposal

The two simultaneous "Blue Book" orders (R.94-04-031 and I.94-04-032) set in motion the process of restructuring California's electric power industry. A particularly significant feature was that they broke the "taboo" of retail wheeling.[34] The CPUC's core objective was to lower the State's electricity prices.

> While our minds are open to modifications of our proposal, or even to the substitution of what we could come to be convinced is a superior suggestion, we are single-minded in its objective -- to lower the cost of electric service to California's residential and business customers without sacrificing the utility's financial integrity.[35]

5.3.1.1 Proposal Details

In order to accomplish this objective, the Commission believed that a fundamental reform of the utility industry and its regulation was necessary, for three reasons:[36]

- Command-and-control and cost-of-service regulation, and government central control planning, are fundamentally at odds with, and ill-suited to, the increasingly competitive electric services industry confronting California and its utilities;
- California's investor-owned utilities currently charge some of the highest prices in the country; and
- This Commission has actively promoted when appropriate policies designed to harness market forces and establish market-based regulatory structures in each of the industries it oversees, including the electric services industry.

The commissioners felt that a long-term focus and a process marked by negotiation and consensus, rather than litigation, would be most beneficial for creating a solid new industry structure.[37] The "Blue Book" also included a set of fundamental principles on which the Commission's vision of the future was based:[38]

- California's consumers gradually enjoy direct access to generation suppliers, marketers, brokers and other service providers in the competitive market for energy services.
- All of California's consumers have a reasonable and fair opportunity to enjoy the benefits of an increasingly competitive electric services industry.
- California's consumers enjoy direct access to the most efficient, environmentally sound electric services infrastructure available.

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[33]California Public Utilities Commission, 20 April 1994. They are referred to as the "Blue Book" because of the color of the cover of the publication they were issued in.

[34]Source: "Retail Wheeling: The Taboo is Crumbling."

[35]California Public Utilities Commission, 20 April 1994, 1.

[36]Ibid., 6.

[37]Ibid., 7.

[38]Ibid., 12. Note: These are also listed in Appendix A of this thesis.

- Competitive electric services make a significant contribution to growth, productivity, competitiveness, and job creation throughout the state's economy.
- All Californians enjoy universal access to a basic and affordable package of electric services which reflects and keeps pace with innovation taking place in the broader, competitive market for electric services.

With these fundamentals to guide it, the Commission outlined a sketch of what a restructured industry might look like, which included a list of 33 proposed policies.[39] One of these was a staged process by which electricity consumers would be given access to choose their electricity generation supplier. The first set of customers to be given such a choice would be those who take power at the transmission level -- large industrial companies (who would receive it on 1 January 1996) -- and the last would be residential customers (who would receive it on 1 January 2002).[40] The "Blue Book" set a broad conceptual framework for industry restructuring; at the same time, the CPUC recognized that its work was merely beginning, and it set an ambitious plan for further hearings and debate to flesh out the details.

5.3.1.2 Action After The "Blue Book" Proposal[41]

According to its timetable, in August 1994 the Commission was to have made its first set[42] of final rulings, which would have determined the criteria for eligibility for direct access and for utility participation in the direct access customer generation market. However, the proposed rulemaking touched off an intense debate, and consequently, the timetable was pushed back significantly. By December 1994 it was clear that a consensus would not easily be reached, so the Commission retreated from its already delayed timeline and charged a working group, which consisted of all interested parties, to hammer out some of the contentious issues, such as: unbundling electric service, public policy programs, resource procurement and diversity, and cost recovery mechanisms.[43] This group submitted a report to the Commission on 22 February 1995 that was also shared with the Legislature. By 24 May 1995, when the CPUC made its next ruling, the Commission had held 16 public meetings accross the state and it had received over 10,000 pages of written testimony, and filed comments from 140 individuals and organizations. The input also included at least six general restructuring models,[44] two of which surfaced as leading contenders for adoption, and one eventually became the "preferred" model.

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[39] For the entire list, see Appendix A of the "Blue Book."
[40] California Public Utilities Commission, 20 April 1994, 60.
[41] For an excellent discussion of this, see: Holden, 28 November 1995.
[42] The planned August rulings would have answered a limited number of questions, with many other sets of rulings planned for late 1994, 1995 and beyond.
[43] Sources: "CPUC Crafts New Utility Restructuring Schedule;" and CPUC, May 1995, A3.7-A3.8.
[44] Source: "Electricity Regulators Split in California,"

5.3.2 POOLCO

In its May 1995 ruling, a 3-1 majority of the Commission supported a pool-based market structure,[45] which would resemble the British Pool.

5.3.2.1 Functional Disaggregation

While the vertically-integrated ownership structure of electric utilities would remain under the proposal, the utilities would be functionally disaggregated. How this would be done is described in the following sections.

5.3.2.2 Generation

The proposal finds generation to be a competitive industry with the potential for heightened competition in the future. As a result, an underlying goal is to establish a fully competitive generation market, to which all classes of ratepayers would have beneficial access. In order to ensure that a truly competitive market would develop, the CPUC would monitor the concentration of generator ownership.[46]

5.3.2.3 Transmission

The proposal assumes that "transmission retains the attributes of a natural monopoly."[47] Instead of opting for the more drastic step of ownership divestiture, the proposal attempts to control vertical market power through a transmission system that would continue to be owned by the utilities but would be controlled by an independent system operator (ISO).[48] The ISO would be subject to regulatory oversight by the FERC. The utilities would be allowed a stream of income from their transmission assets once the Commission is assured that the ISO operates independently of those with beneficial interests in the system. The CPUC delineated three major benefits of this transmission structure:[49]

- Permanent resolution of disputes between transmission owning and dependent utilities;
- Efficiencies of a single state-wide system; and
- Inability of any participants to game the system through its control.

The ISO would also be responsible for maintaining system reliability by arranging back-up and ancillary services and would manage emergency responses, reserves, and grid

[45]CPUC, May 1995. Henceforth, this proposal will be called either the California POOLCO proposal, or POOLCO.

[46]The proposal was unclear as to how concentration would be defined or monitored. These topics were explicitly left open for comment. Source: CPUC, May 1995, 50.

[47]CPUC, May 1995, 7.

[48]The exact control duties of the ISO were not specified.

[49]Paraphrased from: Ibid., 8.

congestion. Construction of new transmission lines would be signaled by congestion pricing, with the exact mechanisms yet to be determined.

5.3.2.4 The Market

The independent system operator would also have responsibility for "making a transparent market for generation with price signals evident to immediate users and long-term investors."[50] The ISO would implement rules for bidding that would be common to all generators, whether they be utility or non-utility, in-state or out-of-state. The lowest cost bidders on a half-hourly or hourly basis would be dispatched by the ISO, and they all would be paid a uniform price.[51] Exceptions to this protocol would be the dispatch of existing QF and wholesale contracts, which would occur in compliance with contract terms; and utility nuclear and hydroelectric plants, which would be exempt from the bidding process. Utility distribution companies would be required to buy their non-wholesale requirements from the pool and other distribution entities, such as municipal pools, would be invited to do so as well. Price information from the pool would send signals for the need for new generating capacity.[52] The FERC would have jurisdiction over the functioning and rates of the pool.

The pool system would allow for "bilateral contracts" through "contracts for differences" -- where parties who are risk-tolerant and risk-averse would consummate agreements that would shield the risk-averse parties from the vagaries of the spot market; but at the same time, the pool would maintain a transparent market price. After two years, the CPUC would review the situation in order to ensure that the pool structure was not precluding such virtual bilateral contracts. If the assumption is incorrect at that time, the CPUC would allow for different mechanisms to create more direct, physical, bilateral contracts. The Commission would also permit bilateral contracts once the pool is established and refined and once the Commission is convinced that five logistical concerns have been alleviated.[53] Thus, the pool structure would be established with the intent of being permanent, but with the understanding that it could be modified and evolve into a bilateral structure, or some

[50]Ibid., 9.

[51]The method for determining this price, and what would be included in it (i.e. components of Equations 2.8 and 2.9) was explicitly not defined. Source: CPUC, May 1995, 29.

[52]The volatility of the spot market could have an impact on the "reliability" of these price signals.

[53]The five are: "(1) establishment of a means to recover transition costs; (2) determination of the technical feasibility of retail, physical bilateral contracts; (3) resolution of jurisdictional uncertainties; (4) establishment of a mechanism (which we foresee requires approval by FERC) by which customers choosing to negotiate retail, physical, bilateral contracts compensate utilities for imposition of costs on the transmission system associated with non-pool transfers; and (5) all horizontal market power issues have been resolved." Source: CPUC, May 1995, 47.

combination of the two. A primary reason for establishing a pool first was a belief of the CPUC that it would be easier to develop logistically than a bilateral structure.

5.3.2.4 Distribution

The distribution system would remain as it currently exists. The three major investor-owned utilities (IOUs) would purchase all of their generation requirements from the pool. Other distribution entities, such as municipal utilities, would be invited (but not required) to purchase from the pool also.

The CPUC also considered other proposals before issuing its ruling favoring POOLCO.

5.3.3 Bilateral (Direct Access) Model

While a majority of the Commissioners supported the POOLCO model, many parties to the debate, including Commissioner Jessie J. Knight, were critical of it.[54] In his May decision dissent, Commissioner Knight said,

> A mandatory POOLCO structure offers NO advantages over direct access[55] with respect to: (1) achieving the goals of decreasing electric rates for California's consumers; (2) addressing past utility commitments fairly; (3) providing all consumers access to the benefits of competition; (4) continuing to deliver vital public purpose programs; (5) maintaining safe and reliable service; and (6) avoiding current state-federal jurisdictional uncertainties.[56]

Commissioner Knight then forwarded a counter-proposal that was as detailed as the majority proposal

5.3.3.1 Generation

The proposal asserts that generation is "a fully competitive service."[57] In order to take advantage of that, the proposal would allow all customers the opportunity to contract directly with competing generators in two years.[58] The generators would receive lighter regulatory oversight than utility generators currently face, and would compete with one another in a fashion similar to other competing businesses in a free market economy.

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[54]In fact, during the deliberations that preceded the CPUC's decision, only SCE, SDG&E, and the California Energy Commission were staunch supporters of the POOLCO proposal. Source: Knight, 1995, Foreword page 4.

[55]Direct access is Commissioner Knight's term for a bilateral system, where customers, generators, and aggregators can consummate agreements without going through a power pool entity.

[56]Source: Knight, 1995, Foreword page 4.

[57]Knight, 1995, 1.

[58]Two years from the effective date of the Commission's decision, presumably 1 January 1998.

Utilities would be required to separate ownership of their generation assets (including nulcear and hydroelectric plants) from their transmission and distribution facilities in order to: prevent market power abuse, reduce regulatory burdens, and ensure fair calculation of stranded costs.[59] This divestment could be accomplished through an auction, spin-off,[60] or any other market based (non-governmental administrative) mechanism approved by the CPUC. The result would be a generation segment of the industry that is financially independent of the "downstream" transmission and distribution functions.

5.3.3.2 The Market

Two types of customers would exist: utility service customers and direct access customers. Utility service customers would "continue to receive bundled service from a transmission and distribution company"[61] and would be protected by CPUC performance-based regulatory oversight with strict performance criteria. Direct access customers would contract directly with generating companies or market intermediaries (marketers and brokers). The exact mechanisms by which direct access customers and distribution utilities would purchase their generation requirements would be left to the discretion and development of the market.

5.3.3.3 Distribution

The IOUs would continue their distribution functions in the form of Electric Distribution Companies (EDCs). An EDC would "retain its obligation to serve all customers who choose to remain utility service customers. The EDC also has an obligation to provide distribution services to those customers who choose direct access."[62] Distribution service would be subject to PBR oversight by the CPUC. Once a customer decides to surrender its status as a utility service customer, it foregoes some of the Commission's protections. If the customer wishes to return to utility service customer status, the EDC would be allowed to pass along directly to the customer the true cost of the additional power needed to supply the customer.[63]

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[59]Knight, 1995, 59.
[60]Or through a combination of auction and spin-off. The assets could be sold all together, in lots, or one-by-one. For market power reasons, the lot or one-by-one method would be preferable. Source: Knight, 1995, 62-63.
[61]Knight, 1995, Executive Summary page 1.
[62]Ibid., 24.
[63]Ibid. Residential and non-residential customers would be treated differently. For details see: Ibid., 25-26.

5.3.3.4 Transmission

The IOUs would retain their duty to provide transmission and ancillary services[64] and would retain ownership of transmission assets and responsibility for their maintenance. In the restructured industry, IOUs would bear the added duty of providing these services in a comparable, non-discriminatory manner that is necessary to support direct access.[65] In order to facilitate this, the transmission system would be operated by an independent system operator, termed OPCO, which would be financially independent of all distribution and generating companies. OPCO's functions would include: "ensuring open access to all participants; maintaining system coordination and reliability; and settling imbalances that might occur on the system due to changes in demand or delivery."[66] OPCO would also be responsible for system planning, emergency responses, reserves, and grid congestion management[67] and would operate the system in compliance with Western Systems Coordinating Council (WSCC) standards. OPCO would control the minimum amount of resources necessary to keep the system functioning reliably[68] and would provide or procure ancillary services. The OPCO would be indifferent to the financial dealings of the market and would explicitly not perform a centralized bidding function.[69] "Other support services, such as loss compensation service and spinning reserves, may be procured from a third party provider."[70]

The protests of Commissioner Knight and others led to a further protraction of the debate. In seeking a resolution, some found it desirable to lay out the differences between the proposals.

5.3.4 Principal Differences Between the POOLCO and Bilateral Models

Three primary differences have been identified between the two models,[71] which are outlined in Table 5.2. The most significant difference involves the role of the Independent System Operator. While both proposals call for an ISO, its role is rather different in each case. The bilateral model provides a narrow role for the ISO -- coordinate power flows and keep the system running through the provision of ancillary services, etc. In comparison,

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64 Knight, 1995, 24.
65 Ibid., 25.
66 Ibid., 30.
67 Ibid., 32.
68 The proposal does not indicate how this minimum threshold would be determined.
69 Knight, 1995, 30.
70 Ibid., 32.
71 Stalon and Woychik, February 1995, 13-14.

the POOLCO model has the ISO conducting another function -- least cost dispatch. The bilateral proposal would avoid the least-cost dispatch function through the creation (by private entrepreneurs, not the state) of market intermediaries that would link customers with generators.

Table 5.2: Differences in How Functions Are Structured

Major Functions	POOLCO Model	Bilateral Model
Control grid operation so as to preserve reliability and facilitate competitive markets.	ISO facilitates a spot market for power at marginal cost prices, schedules power flow of bilateral contracts, operates a clearing house for participants in the spot market.	GENCOs, users and non-regulated market intermediaries make market(s). The ISO does not operate a clearing house.
Dispatch plants and operate system to serve "the market."	ISO administers *least cost dispatch.*	ISO administers *contract dispatch* (PG&E model uses as-bid price offers).
Transmission operation.	ISO coordinates generation and transmission to minimize combined generation and transmission costs.	ISO manages generator use and transmission congestion to facilitate bilateral trades.

Source: Stalon and Woychik, July 1995, 66.[72]

While these differences are significant, the two models are not as fundamentally different as they appear. Inherent in both is the question "not *whether* to pool, but *how* to organize power pooling."[73] POOLCO supporters maintain that their system would inherently achieve least-cost dispatch,[74] while bilateral supporters claim that their model too would converge to that point because traders, who would be connected to real-time electronic systems, would swap contracts to take advantage of lower-cost supplies until the efficient market clearing price is reached. Bilateral supporters also claim that the presence of these intermediaries would unleash new competitive, price-lowering avenues that would not exist when all power is traded through a monopsony/monopoly intermediary.[75] In reply, some POOLCO proponents view market intermediaries as "the forces of evil"[76] who are out to seek a quick buck in the midst of what would be a very confusing market to consumers, at least at first. From this discussion it should be evident that the differences separating the two camps are as much ideological as they are functional. With such a gap it became clear

[72]The original table had two more sets of differences: transmission pricing and contract imbalances services. These were differences between proposals forwarded by industry players, such as ENRON, PG&E, SCE, and SDG&E, not between the Commission majority and the Knight proposals (which were both silent on these issues).
[73]Stalon and Woychik, July 1995, 64.
[74]Garber *et al*, 1994; and Hogan, September 1994.
[75]Tabors, 13 November 1995; and Stalon and Woychik, February 1995, 21.
[76]Hogan, 19 October 1995.

that neither side would be persuaded by more debate or facts[77] and that a compromise needed to be developed outside of the framework of the two proposals.

5.3.5 Hybrid Model

As the debate dragged on the Commission moved toward a hybrid of the two models.[78] This came about due to intervention by the staff of Governor Pete Wilson,[79] who notably stayed out of the debate.[80] In September 1995, "formerly warring parties ... reached important accommodations that may well shape the next steps for restructuring in California."[81] This negotiated agreement, between Southern California Edison (SCE)[82] and formerly antagonistic groups,[83] embodied in a Memorandum of Understanding (MOU),[84] outlined a future for the industry that gained acceptance, even among its critics.[85] The MOU called for the creation of an ISO that would: schedule power transactions, manage congestion equitably, and provide non-discriminatory and comparable access to the transmission network; and a *separate* entity that is responsible for managing a spot market power auction (the Power Exchange). The significant changes from the Commission's May decision are the decoupling of the system control and spot market functions of the ISO, and the more voluntary nature of the pool, i.e. direct, bilateral contracts would be allowed immediately.[86] In return for these concessions on the part of SCE, the large power users agreed to a 100% stranded cost recovery principle.

The MOU, while a significant piece of work, was merely a compromise between the state's second-largest utility and some opposing interest groups. Only the CPUC could turn these ideas into state policy. Because many of the MOU's details found their way into the Commission's final ruling, we will refrain from providing any further specifics of the document here.

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[77]Stalon and Woychik, February 1995, 22.

[78]Tabors, 19 October 1995.

[79]Source: "A Nasty Shock."

[80]A scathing *Wall Street Journal* editorial criticized Governor Wilson for campaigning for President while the deregulation efforts in his state were flailing. Source: Boot, 1995.

[81]Woychik, November 1995, 32.

[82]A chief proponent of the POOLCO model.

[83]Supporters of the bilateral model: The California Manufacturers Association, the California Large Energy Consumers Association, the Independent Energy Producers, and Californians for Competitive Electricity.

[84]Southern California Edison, 1995.

[85]Source: "Almost There in California Restructuring."

[86]Subject to a phase-in timetable. See: Southern California Edison, 1995, B-1.

5.3.6 A Final Model?

On 20 December 1995, the CPUC issued a ruling[87] that it anticipates will serve as "the foundation for California's emerging market institutions and regulatory reforms,"[88] barring legislative, judicial, or FERC intervention.[89] On a 3-2 vote,[90] the CPUC supported a model that is based largely upon the MOU. The ruling is also much more forthcoming with details than previous CPUC decisions -- as evidenced by its 240-page length -- and represents "a much matured description of market institutions and a much clearer view of the role of customer choice."[91] Let us now examine the pertinent details of the CPUC's proposal.

5.3.6.1 Generation

At the heart of the Commission's decision is the creation of a competitive generation market. Starting in 1998, IOUs would be required to bid all of the electricity they generate into the Power Exchange[92] during the transition period.[93] (Generators, currently owned by the utilities but subsequently sold to non-affiliated parties, would be exempted from this requirement upon transfer of ownership.)[94] At the end of the transition period, the IOUs would be eligible to sell their power through whatever mechanism(s) they deem most appropriate.[95] Non-IOU generators would also be welcome, but not required, to bid their generation into the Exchange.

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[87]CPUC, D.95-12-063. It should be noted that this was revised, for grammatical corrections, on 10 January 1996. Once again, it passed on a 3-2 vote. Thus the final decision is D.96-01-009. This thesis is working off of D.95-12-063, with a supplementary list of the 27 changes proposed for D.96-01-009. The text that the thesis uses was obtained from the Internet at the CPUC's World Wide Web site. There were some pagination problems with the text obtained in this manner so the page numbers indicated in the footnotes for citations are approximate. Henceforth, this will be referred to as the California Final model or the Final model.

[88]CPUC, D.95-12-063, 23.

[89]The CPUC waited 100 days for legislative review before implementing the decision. The CPUC will also have an environmental impact statement developed. Both of these processes could lead to further changes to the proposal.

[90]The two dissenters, Jessie Knight and newcomer Josiah L. Neeper, held out in favor of a more pure "bilateral" approach. Source: "California Regulators Approve Plan to Deregulate Market for Power by '98."

[91]CPUC, D.95-12-063, 1.

[92]See section 5.3.6.6 for a description of the Power Exchange.

[93]An important and controversial provision of the Commission's proposal is that the IOUs are given the opportunity to recover 100% of their stranded investments, although at a discounted rate-of-return. The period 1998-2003 is the transition period during which these stranded investments will accrue. A non-bypassable competitive transition charge (CTC) will be collected until 2005 to pay for the stranded investments. After that date, utilities would be able to recover only uneconomic QF and long-term wholesale power contracts.

[94]Once sold, the new owners of these generators would be eligible to sell power to whomever they desire. However, the sale of some of its assets would not exempt the utility from the requirement for those it retains.

[95]CPUC, D.95-12-063, 53.

Central planning of new generation facilities would cease to exist. Instead, the Commission believes that the creation of a transparent price in the Power Exchange would provide potential investors with sufficient information to make investment decisions and attract sufficient capital.[96]

A lingering concern of the CPUC is that horizontal market power could undermine the benefits of competition. Based upon extensive studies, the proposal requires Pacific Gas and Electric (PG&E) and Southern California Edison (SCE) to develop individual plans for the voluntary divestment of 50% of their fossil fuel generation capacity through a spin-off or sale to a non-affiliated entity. Until these assets are divested or the transition period ends, whichever comes first, utility generators would continue to be subject to CPUC performance based regulation.[97]

5.3.6.2 The Market

By the year 2003, all customers would be presented with three broad categories of choices for procuring their electricity service.[98] Between 1998 and 2003, increasing numbers of customers would become eligible for all three options, with option one being the default for those who are not yet eligible for the other two.[99]

5.3.6.2.1 Option 1: continued service from the local utility

The first category of options would allow a customer to continue to receive service from the same investor-owned utility distribution company (UDC) that serves him in the current industry structure.[100] The UDC would be responsible for procuring generation and transmission services for these customers, termed utility service customers, who would in turn be given the option of having their rates calculated (1) using an average electricity rate or (2) using virtual direct access (time of use) rates (provided they have appropriate metering equipment.

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[96]Some process for developing renewable energy technologies and a diverse resource supply would likely continue. See: CPUC, D.95-12-063, 146.
[97]CPUC, D.95-12-063, 85.
[98]This is true of customers who are currently served by investor-owned utilities. Customers of municipal utilities might be entitled to these options, but the CPUC does not have oversight over public power agencies so it can not mandate competition for them.
[99]One important aspect of the phase-in schedule is that as the levels of customer participation increase, a representative group of customers will become eligible (i.e. customers from each customer class will be eligible for access to options two and three). The original "Blue Book" phase-in schedule allowed large industrial customers the first opportunity for direct access, then small industrial customers, etc., with residential customers receiving the last opportunity.
[100]Or retains it by default until 2003 or before.

5.3.6.2.2 Option 2: financial hedging contracts

The second category of options would be for a customer to buy electricity at rates that incorporate financial hedges. Essentially the customer would "lock in" a price (or a narrow price range) with another entity that is willing to bear the vagaries of a fluctuating electricity spot market price. The customer would continue to purchase her power through the UDC (who would retain responsibility for acquiring the necessary generation). In addition, she would have a hedging contract to settle with another party on a periodic basis.[101] The Commission proposes no limits on who can be the "risk-bearer," it wishes to leave the hedging functions open to the "genius of the marketplace and the will of market participants."[102]

5.3.6.2.3 Option 3: direct, physical bilateral contracts

The third broad category of customer choice would be the ability of a customer to negotiate a direct, physical, bilateral contract with a generating company. According to the terms of these contracts, sellers agree to dispatch specific generators on fixed financial terms to its consumers. In reality, the customer receives electrons that are commingled with others on the grid. Instead of dealing with a generation company directly, a customer could also deal with an aggregator -- a financial intermediary who attempts to aggregate loads in order to better match the needs of customers and generators.

5.3.6.2.4 Customer education and protection[103]

The Commission is giving consideration to two actions that would help ensure that customers are sufficiently educated to take advantage of their new choices and are not defrauded. The first of these is the creation of an independent trust, whose proceeds would be used to educate consumers on the new electric power structure. The second action would be the creation of a registration or licensing process for electric service providers, including marketers, brokers, and aggregators.

[101]The Commission envisions that a hedging contract would work something like as follows: "A customer who has formed such a contract continues to receive a bill from the local utility which reflects both the cost of electric power and distribution services. Periodically, such a customer totals the amount of these payments to the local utility and determines whether they exceed the price guarantee concluded in the hedging agreement. In that event a bill is submitted to the other party who reimburses the customer so as to bring the cost of electricity for the period to within the agreed maximum." Source: CPUC, D.95-12-063, 1995.

[102]CPUC, D.95-12-063, 7.

[103]Ibid., 186-188.

5.3.6.2.5 Requirements of UDCs for utility service procurement

Until the completion of the transition period, the UDCs would be required to purchase the power for their utility service customers from a newly formed entity, the Power Exchange. At the end of the transition period, the UDCs would be able to purchase power from whatever source(s) they finds most efficient.[104]

5.3.6.2.6 The Power Exchange

The Power Exchange, which would be financially independent of all generation and distribution companies as well as the ISO, would "foster and sustain the development of a transparent spot market price for the generation of electricity."[105] The Power Exchange would estimate how much power would be needed to supply non-direct access customers during half-hourly or hourly blocks; and based upon these results, conduct an auction for electricity generation on an half-hourly or hourly basis. This auction would occur the day before the generation would be provided. The Power Exchange would be responsible for implementing "nondiscriminatory rules which permit rival generators to compete on common grounds using transparent rules for bidding into the Exchange."[106] While individual generators would receive varying prices for their power based upon the auction clearing price adjusted for spatial transmission costs, customers would see one single market clearing price. Out-of-state and public power generators would be welcome to bid into the Exchange. The Power Exchange would be regulated by the FERC.

5.3.6.3 Transmission

The Commission finds that "transmission retains the attributes of a natural monopoly and will be consolidated, from an operational perspective, in the Independent System Operator,"[107] which would become

> the essential entity to coordinate the daily scheduling and dispatch activities of all market participants as required to meet the critical objectives of providing open, nondiscriminatory access to the transmission grid while preserving reliability and achieving lowest total cost for all uses of the transmission system. The unavoidable interactions in the transmission network require the services of a system operator to coordinate the actual use of the system and apply a pricing structure that supports competition and avoids cost shifting.[108]

[104]Ibid., 53.
[105]Ibid., 12.
[106]Ibid.
[107]Ibid., 93.
[108]Ibid., 14.

Specifically, the ISO's duties would be to:[109]

- Take primary responsibility for the determination of the final operation and dispatch of the system in order to preserve reliability and achieve the lowest total cost;
- Maintain frequency and control in compliance with North American Electric Reliability Council (NERC) and Western Systems Coordinating Council (WSCC) standards;
- Provide open and nondiscriminatory transmission services and access to all users;
- Procure ancillary services from suppliers -- whenever possible this should be done through a competitive, unbundled process;
- Coordinate day-ahead scheduling and balancing of the transmission grid;
- Coordinate the scheduled nominations from the Power Exchange and bilateral agreements and redispatch in order to assure reliability and least-cost use of the system;
- Calculate congestion and spatial and temporal marginal costs in advance of the Power Exchange auction so that these costs can be used to help define the market clearing price of the auction;
- Coordinate and implement final scheduling and last-minute redispatching of generators;
- Collect transmission and congestion charges and administer congestion contracts; and
- Provide a system of open communication for the scheduling market -- keeping individual bids and nominations confidential while making public all other reasonable information regarding power flows, market clearing prices and the state of the transmission system.

The ISO, like the Power Exchange, would not be financially connected to any market participant. Its role would be short-term: facilitation of day-ahead scheduling and hourly redispatch of generators in order to balance the system and respect transmission constraints. In order to do so, the ISO would redispatch the nominations of the Power Exchange and bilateral contract exchanges with indifference to the source or use of power. Thus, the time scale of ISO functions would include day-ahead scheduling, hourly dispatch, and those actions on the order of seconds and minutes to keep the system functioning. The ISO would also determine the "rational economic prices to apply to all uses of the transmission grid in order to ensure that the associated incentives are consistent with the competitive market and least cost use of the transmission system."[110] Marginal cost-based price calculations would include temporal and spatial considerations. While an exact pricing scheme has yet to be established,[111] the proposal states that it should include

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[109]Summarized from: Ibid., 30-37.

[110]CPUC, D.95-12-063, 16. In the May decision the Commission recognized three benefits to having an ISO operate the system (see: Section 5.3.2.4). The December decision recognizes a fourth benefit: "there will be a consistent pricing system for the use of the common network facilities that prevents cost shifting and supports the competitive market." Source: D.95-12-063, 29.

[111]This will likely be an issue of significant controversy. While there is no fundamental reason to do so, those supporting bilateral contracts have generally supported zonal pricing, while those supporting the POOLCO model have advocated nodal pricing.

a system of transmission congestion contracts that would be administered by the ISO. The FERC would have regulatory oversight over the policies of the ISO and the transmission rates it charges.

Although transmission assets would be operated by the ISO, the utilities would retain ownership of them. The proposal directs the utilities to develop mechanisms for recovering the fixed costs of transmission and for prospective investments in transmission upgrades.[112] The CPUC would like to have new transmission investments signaled by the market, as opposed to being requested through contentious administrative processes.[113] In order to prevent utilities from delaying transmission line construction so that they can take advantage of "strategically placed" generators (in terms of transmission line congestion), the ISO could be allowed to collect congestion rents which it could use to construct new transmission facilities.[114]

5.3.6.4 Distribution

Investor-owned utilities would retain their distribution function by providing service for all customers, not just those who choose to remain utility service customers.[115] The obligation to provide full service (utility service customer service) would extend even to those customers who have left utility service in favor of bilateral contracts and wish to return to utility service customer status.[116] The UDC also retains its obligation for least-cost service to utility service customers. Even if this distribution service is minimal, it is important that every electric transaction that is currently deemed retail be considered to have a distribution component for jurisdictional reasons.[117] Implicit in the previous sentence is the continued regulation of distribution rates, terms and conditions by the CPUC. It is the intent of the Commission to switch from rate-of-return regulation to PBR mechanisms.

[112]CPUC, D.95-12-063, 40.

[113]Ibid., 41. Perhaps a longer-term (than the sport market) view will be necessary for this to occur. For example, long-run marginal cost pricing and/or a mechanism that accounts for cumulative savings over the life of new equipment that result from the upgrade (compared with the base physical case).

[114]This too has yet to bè resolved. The CPUC's statement on this is only a suggestion on ways to prevent market power abuse, not a final decision. Source: CPUC, D.95-12-063, 95. Some analysts, such as William Hogan, believe that this would create perverse incentives for the Independent System Operator. Source: Hogan, 19 October 1995.

[115]These are the customers who choose "option 1." (See: Section 5.3.6.2.1)

[116]In fact, the UDC is not allowed to delay or tariff utility service resumptions.

[117]A primary reason for this is that maintaining a distribution component would allow the CPUC to collect money for the CTC and other public purpose programs. Source: CPUC, D.95-12-063, 46.

5.3.7 Other Models

While the POOLCO, bilateral, and hybrid models rose to the top of the agenda in the California debate, there were several other restructuring models that received consideration. Although they were not adopted in California, that does not mean that they will be forgotten -- since it is expected that different states will adopt different models. Therefore, let us briefly examine them.

5.3.7.1 Regional Transmission Company Model[118]

The principal feature of this model would be that an entity (a public agency or private firm) would purchase all of the transmission assets in the state and create a state-wide regulated transmission monopoly. The new transmission monopoly would operate the system. Its duties would include the provision of economic dispatch and grid support. Generation would become a fully competitive business and distribution would stay as it is, with jurisdictional utilities providing service. The revenues from the sale of the transmission assets would be used to pay for stranded investments and to pay off the bonds of municipally-owned generators.

5.3.7.2 Municipal Choice Model (McPool)[119]

Another proposal, generally supported by municipal power agencies, would focus on enhancing wholesale power competition. It would develop transparent pricing and open access transmission tariffs and electricity pricing bulletin boards. The pool would only be open to distribution entities, unless the distribution company in an area specifically allows its customers direct access to the pool. Transmission congestion rents would be used specifically to pay for additional transmission capacity. The ownership of the transmission system would be consolidated into a Grid Company, whose shareholders would be the distribution companies in its service territory who wish to have an ownership stake in it.

5.3.7.3 Community Access Model[120]

Slightly different than the McPool option is one that would allow community entities to form and to purchase electricity on the wholesale market on behalf of their customers. These community groups would aggregate the electricity demand within their geographic area, but would differ from municipal utilities in that they would not acquire distribution assets. Instead they would purchase distribution service from the IOUs at CPUC regulated

[118]CPUC, May 1995, A3.21.

[119]Southern California Public Power Authority, 1995; Stalon and Woychik, July 1995, 65-66; and CPUC, May 1995, A3.19.

[120]CPUC, February 1995, 7-8; and CPUC, May 1995, A3.20.

rates. The community entities would become responsible for load forecasting and purchasing energy on behalf of all customers -- residential, commercial, and industrial -- in their geographical area.

5.3.7.4 Tehachapi Compromise[121]

The last California proposal that will be discussed is the Tehachapi Compromise. It is rather simple -- the northern part of the state would proceed under a bilateral market structure and the southern part of the state would be based upon a pool model.[122] These would be established on parallel schedules.

5.3.8 The Future

With its final order in place, the CPUC must now garner political support for its decision and enter into its implementation stages. On 31 August 1994 the State Legislature passed Assembly Concurrent Resolution 143, which established a joint committee for oversight of the restructuring process, required the CPUC to meet certain standards, and sought to ensure that the legislature would be properly consulted and involved in the Commission's proposal development process.[123] As a result, the Commission plans to allow 100 days for Legislative review before implementation of its proposal begins.[124] In order to be fully implemented, the proposal will also require several explicit Legislative actions, such as changing the Public Utilities Code and creating new collection mechanisms for public purpose programs.[125] The proposal will further require external review of its environmental impacts.[126] Politically, the proposal will face challenges from both sides of the spectrum: from those who believe, along with Commissioners Knight and Neeper, that the decision does not go far enough; to those who are concerned that it goes too far, such as a vocal Legislative committee chair who is concerned about its impact on small customers.[127]

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[121]CPUC, May 1995, A3.22.

[122]Conveniently, Pacific Gas and Electric, a bilateral proponent, serves the northern part of the state and Southern California Edison and San Diego Gas and Electric, POOLCO supporters, serve the southern portion of the state.

[123]CPUC, D.95-12-063, 219.

[124]CPUC, "Electric Restructuring Fact Sheet."

[125]CPUC, D.95-12-063, Appendix E.

[126]The Commission explicitly mentioned that the order does not become final until the findings of the environmental impact statement are considered. Source: CPUC, D.95-12-063, 217.

[127]Sources: "California Legislators Sing Restructuring Blues;" "Could Service Issues Unravel Cal. Restructuring?;" and "1st Calif. Restructuring Bill of '96 Would Protect Small Users."

If the proposal clears these "external" hurdles and does in fact serve as the basis for California's electric power industry, the Commission and other interested parties must take many more actions and make numerous decisions in order for a workable industry structure to develop. The Commission has listed 14 "activities" that must occur within the 175 days following the decision alone, with many more anticipated to occur later. Therefore, while the debate may appear over, it is actually just moving into a new phase.

It should be clear from this section that the debate in California has been complicated and involved, but it has been just one piece in the larger puzzle of American electric power deregulation.

5.4 PROPOSALS IN OTHER STATES

At the time this thesis is being written, California is only one of approximately a dozen states that are examining the issue of deregulation.[128] The process and motivations in each varies. Some, like Massachusetts and California, are serving as the trailblazers. Others, such as Rhode Island, are following closely but cautiously behind. The motivations in some cases are obvious -- lower rates. California's prolonged economic slump and Massachusetts' manufacturing woes,[129] when combined with both states' high electricity rates and free market-oriented governors served as effective catalysts for change. In other cases, the motives are less self-evident. For example, Wisconsin, which has some of the lowest electric rates in the nation, is moving to deregulate almost as quickly as California.[130] This is the result of an interesting combination of restructuring proponents: electric utilities who are unusually supportive of deregulation,[131] industry leaders seeking lower electric rates, and a group of leaders in the state government who are strong ideological advocates of deregulation.[132] From such an amalgamation of rationales for deregulation it should not be surprising that a number of widely-varying restructuring models have emerged and that more than one will likely gain wide acceptance. With this in

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[128] States that entered the fray early include: Connecticut, Illinois, Maine, Maryland, New Hampshire, New Jersey, New York, Ohio, Rhode Island, Vermont, and Wisconsin. Source: Massachusetts Department of Public Utilities, 16 August 1995, 3.

[129] Lester *et al.*, 1995.

[130] *Energy Daily* noted that Wisconsin is the first state to undertake such proceedings in a situation "that is not marked by a sense of economic and ratepayer urgency." Source: "Wisconsin PSC Launches Restructuring Investigation," 1.

[131] Source: "Total Deregulation in Electricity Sector Would Hurt Customers, a Report Says."

[132] Healy, 30 August 1995. Cheryl L. Parrino, Chair of the Public Service Commission, answers the question -- "With our low electric rates, why should we be doing anything?" -- with "No matter how far ahead you are in the race, if you stand still and refuse to move 'Forward' you will eventually lose." Source: Wisconsin Public Service Commission, October 1995, ii.

mind, let us examine the restructuring efforts that are currently underway in several vanguard states.

5.4.1 Massachusetts

During the Fall of 1995, as the California process languished,[133] the focal point of the national debate arguably shifted to Boston and the Massachusetts Department of Public Utilities (DPU).[134]

5.4.1.1 Initial Steps

In February 1995 the DPU launched an inquiry into restructuring the industry to investigate and determine:[135]

- How a restructuring of the electric industry in Massachusetts would promote competition and economic efficiency and expand opportunities that would benefit customers;
- Whether and how to extend to some or all customers the option of choosing their own electricity suppliers;
- How such a restructuring could be implemented; and
- The appropriate regulatory mechanisms to apply to a restructured electric industry.

While the Commission was investigating, a coalition of utility, business, and environmental groups, the Massachusetts Electric Industry Restructuring Roundtable, developed a set of 18 interdependent principles which it hoped would guide the process in Massachusetts.[136]

5.4.1.2 The DPU's Ruling

In an August, 1995 order, the DPU established its own set of principles that would serve as the basis for a relatively rapid move to restructure the industry.[137] The Commonwealth's three largest investor-owned utilities (Boston Edison, Massachusetts Electric Company, and Western Massachusetts Electric Company) were given 6 months to come up with:[138]

- A plan for moving from the current structure to one that has a competitive generation market and increased consumer choice;
- Illustrative rates and supporting information that, at a minimum, demonstrate unbundled charges for transmission, ancillary services, distribution and generation;

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[133]For a good discussion of the political forces that shaped and delayed the debate see: Holden, 29 November 1995.
[134]Ackerman, November 1995, 87.
[135]Massachusetts Department of Public Utilities, August 1995, 1.
[136]Electric Industry Restructuring Roundtable, 1995. See Appendix A for a listing of these principles.
[137]For a description of the history leading up to the DPU's ruling see: Ackerman, 15 August 1995.
[138]Condensed from: Massachusetts Department of Public Utilities, 1995, 47.

- A stranded cost charge which approximates its magnitude with supporting information; and
- An incentive regulation plan (for transmission and distribution).

The five smaller regulated utilities in the Commonwealth would then be given 6 months from the DPU's ruling on the larger utilities' plans to develop their own. All eight proposals should be based upon the following seven transition principles:[139]

- Provide the broadest possible customer choice;
- Provide all customers with an opportunity to share in the benefits of increased competition;
- Ensure full and fair competition in generation markets;
- Functionally separate generation, transmission, and distribution services;
- Provide universal service (i.e. all residents have access to electricity service);
- Support and further the goals of environmental regulation; and
- Rely on incentive regulation where a fully competitive market cannot exist or does not yet exist.

The DPU's document raised several important issues with regard to transmission:

- In a competitive electric industry, constraints on the transmission system can be constraints on the efficient function of the market itself. Therefore, as the industry makes the transition toward a competitive generation sector, adequate long-term investment in the transmission system is necessary to maintain acceptable levels of capacity, safety and reliability, and to enable the transmission system to support market function. Careful attention must also be focused on issues related to the sitting of new transmission facilities in order to ensure adequate transmission.[140]

- In addition, cross-subsidization is of particular concern in the electric industry, where companies operating simultaneously in competitive and monopoly markets could subsidize competitive services by recovering a portion of the costs of those services through monopoly services. Transactions in a competitive market should occur in an economically efficient manner without undue, and therefore anti-competitive, advantage from affiliations, relationships, or exclusive agreements.[141]

The Department anticipates that the transmission and distribution of electricity will remain monopoly services, and as such, will continue to require regulatory oversight.[142]

> Regulation of transmission services, regardless of jurisdiction, should ensure open access to the transmission grid, comparable pricing of transmission services to all users including the owner, and adequate levels of investment to ensure that the transmission system remains reliable and is expanded as appropriate. Any incentive proposal pertaining to transmission should promote simplified procurement of transmission services and the efficient use of transmission assets. Prices for transmission services should, to the extent possible, promote efficient use of the transmission system so that the system constraints are minimized and transmission capacity is well-utilized.[143]

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[139]Excerpted from: Massachusetts Department of Public Utilities, 1995, 15-17.
[140]Massachusetts Department of Public Utilities, 1995, 21.
[141]Ibid., 22.
[142]Ibid., 28.
[143]Ibid., 29.

5.4.1.3 NEES Proposal

In early October 1995, the New England Electric System (NEES) unveiled a tentative proposal that it intends to present to the DPU for consideration.[144] According to the proposal, retail wheeling would commence for all customers down to the residential level on 1 January 1998. Customers would be given the opportunity to choose their suppliers on a periodic basis and the existing utilities would have the "obligation to offer" service to their current customers. Structurally, NEES would functionally unbundle its generation company and would create a new, separate transmission company. Transmission and distribution rates would be set through performance based ratemaking while generation rates would be deregulated. All parties would be subject to a uniform charge for stranded investment and social programs.

5.4.1.4 Utilities Report Back[145]

On 16 February 1996, the three large utilities plus two of the smaller ones reported back with their reports which varied significantly, ranging from radical restructuring by 1998 to a transition to deregulation with no firm start date. Governor Weld's office also submitted a restructuring proposal.

5.4.1.5 The Future

The State Senate Committee on Post Audit and Oversight issued a report in December 1995 that calls for deregulation.[146] According to the "Senate Post Audit & Oversight Staff Model"[147] that the report proposes, customers would be able to purchase power from an aggregator of choice or directly from generators. The model would also create a pool,[148] which would be responsible for maintaining system reliability and would be the default supplier for customers who do not purchase power from an aggregator. This proposal has been described as "one of the purest approaches to retail competition of the various schemes before state governments."[149]

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[144] Source: "NEES Plans Residential Wheeling."

[145] Material for this section comes from: Ackerman, 16 February 1996, and "Massachusetts Utilities Propose Rate Cuts."

[146] Massachusetts State Senate Committee on Post Audit and Oversight, 1995.

[147] Ibid, 31-33.

[148] The geographic reach of this pool is unclear. In general, the report discusses issues in terms of New England. However, the specific discussion of the pool seemed to imply (although did not explicitly state) that the pool would be limited to Massachusetts.

[149] Source: "Mass. Senate Report Backs Pure Retail Competition."

With the reports of the utilities now in hand, it is expected that the DPU will conduct hearings over the ensuing months and issue a master plan by the end of the year, at the latest. With gubernatorial and legislative support for deregulation, and a stated desire by the DPU to begin deregulation in 1998 (the same target date as California), many eyes across the country will be focused upon Massachusetts during the next two years as it goes through the process of defining, refining, and ultimately adopting its deregulation proposal(s).

5.4.2 Wisconsin

5.4.2.1 The Context

Another state at the cutting edge of the deregulation movement is Wisconsin. Despite having some of the lowest electricity rates in the nation,[150] electric power deregulation will come to "America's Dairyland" in the near future. This rapid embrace of deregulation has arisen from a combination of political entrepreneurship on the part of the state's large utilities,[151] which are well-positioned for deregulation,[152] and those in state government.[153]

In February 1995, a 22-member advisory committee[154] was established by the Public Service Commission (PSC) to develop and recommend actions for the future of Wisconsin's electric industry. The committee examined transmission, generation, and distribution individually, and developed goals & objectives, and restructuring alternatives for each segment. After examining the industry segments individually, the committee developed five options for a consolidated industry structure. In October the committee presented its proposals to the Commission.[155] A majority of the committee's membership favored an "incremental change" approach, which included the creation of an independent system operator for the transmission system in the state and unbundled rate and service options.[156]

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[150] Wisconsin Public Service Commission, July 1995, ix.
[151] Wisconsin Energy, Northern States Power, and Wisconsin Power & Light.
[152] Abdoo, 1995; and "'Merger of Equals' Primes NSP, WEPCO for Competition."
[153] Healy, 1995.
[154] Wisconsin Public Service Commission, July 1995, A10.
[155] Advisory Committee on Electric Utility Restructuring, 1995.
[156] Source: "Camps Vie over Restructuring, As Wisc. PSC Process Advances."

Working in parallel with the advisory committee was the PSC's staff, which prepared an environmental impact statement (EIS). The draft report[157] was issued in July 1995, with a final report[158] issued in October. The EIS examined two market structures: the "status quo" and the "plausible extreme" models.[159] These were chosen as the extreme points on the restructuring spectrum, between which the final ruling of the Commission would likely fall. Let us now take a closer look at the plausible extreme model.[160]

5.4.2.2 The "Plausible Extreme Model"

5.4.2.2.1 Generation

Utilities would be forced to sell their generation assets through an auction or sealed bid process, which would allow for more competition and for a market-based mechanism of calculating stranded costs and benefits. Following divestiture, the only requirements for owning generation assets would be the ability to gain sufficient capital and siting clearance to build a new plant and a belief that one can operate it efficiently enough to survive in a competitive market. Plants would be built and purchased in an uncoordinated manner, with the business judgment of investors, rather than regulators, driving decisions. Government intervention[161] in the financial considerations and market structure of the generation market would be limited to securities laws and anti-trust enforcement. Correspondingly, the government would not assist the siting of competitive generating facilities through the power of condemnation or eminent domain.

5.4.2.2.2 The market

The market for power would be based upon a Pool-based model, by which the pool would determine the spot price and would dispatch the generators. The Pool operator (Poolco)[162] would be totally independent, having no ownership relations with any generation, transmission, or distribution company. In order to manage risks and perhaps facilitate financing, bilateral contracts and forward markets would likely develop both around and on top of the Poolco foundation.

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[157] Wisconsin Public Service Commission, July 1995.

[158] Wisconsin Public Service Commission, October 1995.

[159] So titled because "it bounds the range of options that the Commission and the Wisconsin legislature might realistically decide to implement. It is termed 'extreme' because it envisions eliminating regulation and employing competitive market forces to the maximum degree that the staff believes is possible." Source: Wisconsin Public Service Commission, July 1995, x.

[160] Wisconsin Public Service Commission, July 1995, 4-10.

[161] Aside from typical interventions such as siting and environmental regulation.

[162] Note that "POOLCO" is an industry structure proposal in California, while "Poolco" is the entity that would operates a pool, in this case in Wisconsin.

On an operational level, the Poolco would take bids once a day for generation capacity for the next day. Based upon the demand during the day and the prices that were bid, the system operator would dispatch and curtail generation supply. Also included in the unit-loading order would be transmission and distribution costs and constraints. Not all generators would need to bid into the pool. Others could be "dispatched" based upon bilateral or multilateral contracts which have fixed levels of generation and price. Those that choose this route would still submit their operating profiles to the Poolco so that they could be coordinated with the other system flows. Additionally, the Poolco would provide balancing services for the bilateral contract power exchanges when the specified amount that is generated either exceeds or falls below the actual demand. In short, the Poolco would have responsibility for keeping the system functioning reliably while meeting the contractual agreements of bilateral customers and properly dispatching those who sell and take power from the pool. To do so, the Poolco would have the authority to break the contractual delivery requirements in order to keep the system together when emergencies arise.

5.4.2.2.3 Transmission

Transmission system operating standards would need to be developed by a combination of the Public Service Commission, NERC, the appropriate Regional Transmission Group, and the Poolco. The latter would ensure that these were met, as part of its responsibility for maintaining system stability and reliability. The Poolco would be responsible for obtaining the ancillary services necessary to keep the system functioning, many of which would be purchased through competitive solicitation.[163] These would be paid for either by adding an even, specific amount to the spot price (for power purchased from the pool) or through a specific charge levied to those who purchase power through bilateral contract mechanisms.

The transmission facilities would be owned and maintained by a private transmission company (Transco), which would be a state-wide or regional company. The Transco would not have any ownership affiliation with generation companies. All facilities would be owned and built by the Transco, which would receive a return on its investment through status as a price-regulated statewide monopoly. The Transco would be responsible for providing transmission service in a reliable manner with maximum power throughput.

[163]Competitively-obtained services would include: spinning and non-spinning reserves, load-following, VAR (volt-ampere reactive) support, provision of reactive power, and local area support (in cases that market power would not preclude a competitive solicitation).

The price structure would be designed so that the Transco would recover all of its costs in a manner that would enable expansion of the grid; yet low enough to prevent the taking of monopoly rents. Prices would be simple, with only one charge for service, and would be temporally and spatially insensitive. Those who require special transmission services would be financially accountable for their provision.

Long-term planning should be done in a manner that eliminates any possibility that physical barriers block economically efficient transactions. When additional transmission service is needed, whether it has been anticipated for a long period of time or requested spontaneously by potential economically efficient transactors, it should be built in a timely manner. This timeliness can be assisted by the power of eminent domain. However, the extent to which eminent domain can be used is directly proportional to the role that the State plays in siting decisions.

5.4.2.2.4 Distribution

Distribution systems (investor-owned, cooperatively-owned, and municipally-owned distribution companies) would be broken into two components: Linecos and Retailcos. The Linecos, which would operate as regulated monopolies in defined service territories, would own the distribution facilities that originate at the transmission system and extend to the customer meter.[164] They would be responsible for the construction, operation, and maintenance of distribution facilities at prescribed levels of reliability.

Multiple Retailcos would compete in an unregulated market to serve customers. They would aggregate power purchases from the spot market, generators and other power merchants and would sell power to customers, presumably in a fashion that is tailored to their needs. In this competitive market, Retailcos would need to focus on customer attraction, retention, and satisfaction. No ownership restrictions would be in place and Retailcos would not need licenses to participate in the market. The same company may own a Retailco and a Lineco, although close Commission scrutiny would be necessary in such a case to ensure that no customer information gathered by the Lineco that is not available to all Retailcos would be used by the affiliated Retailco.

The Retailco would charge a distribution access fee to all customers, which would then be paid to the Lineco, based upon rates set by the Commission. In addition to paying the

[164]Rate base regulation would be replaced by price caps and performance-based regulation.

Lineco for service, the access fee would include several other components. These would include:

- A stranded investment fee (or alternatively, a stranded benefit payment); and
- A low Income Assistance fee.

Linecos would have an obligation to serve, but Retailcos would not.

5.4.2.3 The Future in Wisconsin

On 19 December 1995,[165] the Public Service Commission voted to implement a 32-step, phased-in approach to deregulation.[166] The target date for retail competition would be the year 2000.[167] Public utilities would be required to functionally unbundle their generation, transmission, distribution, and energy services businesses, and establish unbundled tariffs and transfer prices for "sales" between existing business units. In the near term, generation would continue to operate rather similarly to how it has in the past, although the PSC would conduct studies on issues such as market power as it looks ahead to a competitive generation market in the year 2000. The transmission system would continue to be owned by the utilities. However, starting in 1997, it would be operated by an ISO, whose functions would be "to achieve nonpreferential operation and coordination of the transmission system, on a statewide or regional common carrier basis, grid-wide pricing, and a specific means of relieving transmission constraints."[168] Should the ISO arrangement fail to mitigate market power concerns, utilities would be forced to divest their assets and a state-wide Transco would be formed.[169] Little would change in the near-term for distribution, although studies of how new regulatory procedures could improve efficiency would be undertaken. The Commission would also take steps to strengthen service territory definitions. Research would be conducted on how to develop the energy services segment of the industry and how to maintain public benefits programs.

Wisconsin is not the only Midwestern state to consider electric power deregulation, its neighbor to the north and east has also been a leader in the issue.

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[165]Beating California to the punch by one day.

[166]Wisconsin Public Service Commission, December 1995. Unless otherwise noted, details of the Wisconsin final proposal come from this document.

[167]Source: "Wisc. PSC OK's New Restructuring Plan."

[168]Wisconsin Public Service Commission, December 1995, 4.

[169]Newman, 1996.

5.4.3 Michigan

While it has somewhat slid into the background, Michigan was the first state in recent years to propose some, albeit limited, form of electric power competition.[170] In April 1994[171] the Michigan Public Service Commission launched the retail wheeling movement by ordering a limited retail wheeling experiment. According to the order, large retail customers -- those who consume 5 MW or more of power -- would be eligible for the retail wheeling trial program. The plan would go into effect when each utility solicits for new capacity,[172] would have a five-year time limit, and only 60 MW of Consumers Power's load and 90 MW of Detroit Edison's would be placed at risk.[173] Each customer could wheel between 2 and 10 MW and they would have to take the wheeled power from certified wheelers at transmission or sub-transmission voltage levels.

Implementation of the proposal faced stiff resistance from Detroit Edison in particular, although the Commission ultimately prevailed in the courts. This plan would go out the window if the State's governor, John Engler, has his way. In a January 1996 development, Governor Engler called for an aggressive plan of retail wheeling for large customers, an ISO-controlled transmission system by 1998, and a dissolution of franchise service territories by the turn of the millennium.[174]

Another recent significant event in Michigan was that the utilities worked hard to keep their best customers, the auto companies, locked into their systems through a series of long-term contracts (5 to 10 years) that give the Big 3 lower prices, reliability guarantees, and free DSM advice, in return.[175]

5.4.4 New Hampshire

A revolutionary set of events is unfolding in New Hampshire, where a company called Freedom Energy is proposing to run a retail wheeling franchise. In June, New Hampshire's Public Utilities Commission (PUC) ruled that the State's franchise agreement

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[170]The "in recent years" clause exists for two reasons. First of all, the early industry was competitive (See Appendix B.2). Secondly, since 1973, large industrial users moving to Georgia have had the ability to secure their power through a competitive bidding process. Source: Southern Company, 1994, 11.

[171]Just 9 days before the landmark California decision.

[172]Gish, 1995, 53.

[173]Sources: "Detroit Edison, AG Challenge Michigan Retail Wheeling Plan;" "Michigan Commission Tries Again, Backs Retail Wheeling Experiment;" "Michigan PSC Approves Retail Wheeling Rates;" Strand, 1994; and Brown, 1995.

[174]Source: "Retail Wheeling Comes Alive in Michigan, Oklahoma."

[175]Source: "Consumers, GM Sign Deal;"

with Public Service of New Hampshire was not an exclusive one and that Freedom Energy could potentially be considered a public utility, if it was found to be in the public interest.[176] In October the PUC set preliminary guidelines for a retail wheeling experiment that is planned to commence in May 1996. Under the proposal, competitive suppliers would have access to 3% of the State's six utilities' demand, which amounts to about 60 MW. All customers would be eligible to participate, and actual participation would be based a random selection of interested customers.[177] The utilities would be able to recover 50% of the stranded investment lost in the process.[178] While Freedom Energy hails the proposal as "a good first effort," the State's utilities are less enthusiastic.[179]

5.4.5 Other States

These five states are a subset of 42 that are actively considering changes in their electric power industry structures.[180] The following is a brief, noncomprehensive sampling of deregulation activities in other states:[181]

- Rhode Island, realizing that as a small state in the large, interconnected New England Power Pool it cannot determine the destiny of its electric industry alone, has worked to forward principles for restructuring in the region[182] and then stand back as the larger Commonwealth of Massachusetts takes the lead.[183] The Massachusetts Interdependent Principles are based upon a set that had been developed several months earlier in Rhode Island.[184] This strategy of the regulators may be upended by a Legislature that is strongly in support of deregulation.[185]
- The New York State Public Service Commission is currently undertaking an extensive proceeding on competition. In response to this, the New York Power Authority has proposed an industry structure somewhat similar to the Wisconsin extreme model, where a combination retail/bilateral market would be developed from which all customers would have access to a competitive market. Generation would be competitive and deregulated, transmission would be owned and operated by the New York Power Authority and subject to FERC regulation, distribution would be a regulated activity (by the Public Service

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[176]Source: "A Franchise By Any Other Name?;" and "Electric Controversy Burns in N.H."

[177]Source: "State Experiments with Retail Wheeling."

[178]Source: "N.H. Commission Sets Retail Wheeling Trial."

[179]Source: "Marketer Cheers Wheeling Trial."

[180]Source: "Will Power Reform Burn Customers," 7B.

[181]A more comprehensive discussion of the state-by-state status in mid-1995 can be found in: "Report of the Committee on Electric Utility Regulation," 1995, 557-564.

[182]Electric Industry Restructuring Collaborative, 1995, 5.

[183]This is the position of the Rhode Island Commission. The Legislature has had other ideas and is actively pursuing deregulation. See, for example: "Rhode Island's Utility-Deregulation Bill Would Set Precedent in Electric Industry."

[184]See Appendix A for the list.

[185]Source: "Rhode Island's Utility-Deregulation Bill Would Set Precedent in Electric Industry."

Commission), and energy service companies would arrange with distribution companies for the delivery of power.[186]

- In Illinois, a proposal for a limited retail wheeling experiment: "Power Quest," proposed by Central Illinois Light Co., is being reviewed by the Illinois Commerce Commission.[187]
- In Pennsylvania, utilities are beginning to push the envelope on deregulation in spite of skepticism by the Pennsylvania Public Utility Commission and its staff. A proposal for a retail limited wheeling experiment has been made in the Pittsburgh suburb of Pleasant Hills.[188] On a larger scale, General Public Utilities and Pennsylvania Power and Light are advocating the creation of a pool-based customer choice deregulation plan.[189]
- In Ohio, retail wheeling has been a hot topic for more than a year. In 1994 a retail wheeling bill was proposed in the Legislature. In October 1995 the state's Public Utilities Commission unveiled a proposal that would allow large industrial customers to buy power from suppliers other than their service utility during a two year pilot program.[190]
- In Connecticut, the state commission, after an extensive process, determined that it is not in the public's interest to commence retail wheeling at this point in time. However, it did recommend that generation be unbundled (although not divested) and that the generation market become competitive.[191]

Having now examined events at the state level, let us now turn to the other forum of electric power regulation, the federal government. While states were working on their proposals, the FERC was attempting to implement the open access requirements of the Energy Policy Act of 1992 (EPAct) by guiding the industry through a series of case rulings.

5.5 FERC "MEGA-NOPR"

Realizing that a more comprehensive framework was necessary, the FERC weighed in with a massive Notice of Proposed Rule-Making (Mega-NOPR) on 29 March 1995. This Mega-NOPR, which consumes 69 pages of the *Federal Register*, has stirred much controversy. It focuses on three major issues: open access to transmission systems, real-time information networks, and stranded cost recovery. Let us examine each of these in turn.

[186]Source: (Not a direct quotation). "NYPA Staff for Direct Access, Statewide Grid and Exchange."
[187]Source: "Retail Access Comes to Illinois."
[188]Source: "Head-to-Head Energy Competition in Pa."
[189]Source: "Competition, Cost Recovery Urged in Pa."
[190]Source: "Ohio Commission's Timid Test."
[191]Source: "Connecticut DPUC Issues Restructuring Recommendations."

5.5.1 Open Access

The FERC believes that "the key to competitive bulk power markets is opening up transmission services"[192] and that "market power through control of transmission is the single greatest impediment to competition."[193] These two beliefs, combined with an intent "to encourage lower electricity rates by structuring an orderly transition to competitive bulk power markets,"[194] led the FERC to issue the proposed rulemaking. In the Mega-NOPR the Commission proposes three broad open access provisions:

- to require all public utilities owning or controlling facilities used for transmitting electric energy in interstate commerce to file open access transmission tariffs;
- to require the utilities to take transmission service (including ancillary services) for their own wholesale sales and purchases of electric energy under the open access tariffs; and
- to create regulations to implement the filing of open access tariffs and the initial rates under these tariffs.

In short, the FERC believes that "transmission service continues to be a natural monopoly,"[195] and that the creation of a competitive wholesale market requires common carrier service on this system.

5.5.1.1 Nondiscriminatory Open Access

In order to prevent market power abuse by transmission-owning utilities (TOUs), the Commission proposes that the national grid be characterized by nondiscriminatory open access rules. According to the proposed rulemaking,

> transmission owners must offer non-discriminatory open access transmission and ancillary services to wholesale sellers and purchasers of electric energy. This will require tariffs that offer point-to-point and network transmission services, including ancillary services. All of these services must be non-discriminatory as to price as well as to non-price terms and conditions.[196]

In developing its non-discriminatory principles, the FERC enumerated the discriminatory actions of TOUs which it seeks to prevent:

- Refusal to provide network service;
- Use of pricing mechanisms that lead to higher prices for those wheeling than for the utility's native load;
- Service prioritization that places wholesale wheeling contracts subordinate to native load uses;
- Difficult scheduling and balancing contractual provisions;
- Restrictions on firm capacity agreements;
- Inferior provision of ancillary services;
- Unreasonable requirements of creditworthiness or security deposits;
- Requirements for reciprocity double payments; and
- Granting of superior provisions to other transmission owning utilities, vis-a-vis non-transmission owners.

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[192] FERC, April 1995, 17663.
[193] Ibid., 17664.
[194] Ibid., 17663.
[195] Ibid., 17675.
[196] Ibid., 17680.

Open access would occur through the posting of tariffs for transmission services. The terms and conditions of these tariffs should be:[197]

- Clear and specific; and
- Free of restrictions or limitations on service, except for cases when verifiable technical or operational needs mandate the limitations.

These tariffs would be available to any entity that can request service under Section 211 of the Federal Power Act. They should be made available for a wide range of time periods, from the transmission provider's minimum scheduling period to several decades (long enough to cover a contract's or plant's lifetime).[198] In the event of insufficient transmission or ancillary service capacity, a transmission utility would be required to make a good faith effort to expand its facilities upon request.[199]

5.5.1.2 Point-to-Point and Network Services

Two broad types of transmission services -- network and point-to-point -- would be available to all system users under the same tariffs (i.e. same rates and terms) that the transmission owner offers itself for its wholesale power sales.[200]

The Mega-NOPR defines flexible point-to-point service as: "deliveries of power from designated points of receipt to designated points of delivery."[201] Such service could be taken or reserved on a firm or non-firm basis. A firm reservation would entitle a customer to a certain amount of transmission capacity during a specified time period, while a non-firm reservation would be subject to interruption (in return for a lower transmission rate).[202] New firm service requests would have priority over new non-firm requests, and would have the same status as new transmission service to the utility's native load.[203]

More extensive than point-to-point service is network transmission service, which the Mega-NOPR defines as follows:

> Network transmission service allows a transmission customer to use the entire transmission network to provide generation service for specified resources and

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[197]Summarized from: FERC, April 1995, 17682.

[198]FERC, April 1995, 17685.

[199]It should be noted that "the (requesting) customer must agree to reasonable terms, conditions and prices, including the financial responsibility for its share of the incremental expansion costs." Source: FERC, April 1995, 17682.

[200]This would be a major change of policy. Currently, TOUs do not charge themselves, nor are they limited to specific terms with regard to their wholesale sales.

[201]FERC, April 1995, 17683.

[202]Firm transmission service could also be interrupted, but this would be the result of technical problems. In the prioritizations that occur during emergency conditions, the firm user would have the same standing as the transmission-provider's own capacity. Source: FERC, April 1995, 17687.

[203]FERC, April 1995, 17687.

> specified loads without having to pay a separate charge for each resource-load pairing. Such service allows a transmission customer to integrate, plan, commit, economically dispatch, and regulate its resources to serve its consolidated load. Network service provides the customer with the same flexible network usage needed to optimize its resources to meet its customers' needs that transmission owners have to optimize their resources to meet their customers' needs. Network service includes the ability to import power from other control areas to economically and reliably service the customers' load.[204]

Network services would also be offered to customers on a firm and non-firm basis.

5.5.1.3 Reassignment of Firm Services

The inclusion of explicit reassignment rights[205] -- the ability of a transmission customer to sell its firm capacity reservation to another party -- would be required in firm transmission tariffs. There would be several benefits to requiring reassignment rights. First of all, such rights would help transmission customers with long-term contracts manage financial risk. For example, if a potential customer did not need transmission capacity immediately, but knew it would need it in the future and would not be able to obtain it at that time, the customer could purchase it immediately and sell it on the secondary market until the customer needed the capacity for its own purposes. Secondly, transmission rights reassignment -- through the assumed creation of a secondary market for transmission service -- would reduce the market power of transmission providers. Thirdly, reassignment rights would lead to more efficient allocation of transmission capacity, since those who value transmission in a given situation more than the rights-holder would be willing to pay a premium for service.[206]

5.5.1.4 Tariff Development (Implementation)

The new tariffs would be developed in a two stage process.[207] In stage one, the FERC would issue generic tariffs, with the exact transmission prices to be set based upon each utility's FERC Form 1 data. The Commission would use postage stamp, embedded-cost based ratemaking in constructing the generic tariffs.[208] Point-to-point rates would be calculated by (1) dividing the total value of the transmission plant in service by the system peak, (2) multiplying by a return on equity factor, and (3) dividing by the total number of hours in a year. The cost for network service would be calculated by (1) averaging the

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[204] Ibid., 17683.

[205] At least for point-to-point services. The Commission is not clear as to whether network or ancillary services would be reassignable. Source: FERC, April 1995, 17685-17686.

[206] FERC's discussion of reassignment rights is found in: FERC, April 1995, 17685-17686.

[207] The Commission is using this two stage approach because it estimates that 137 utilities would be forced to file new tariffs and it wishes to bring the benefits of increased wholesale competition to customers as quickly as possible. Source: FERC, April 1995, 17718.

[208] These are discussed in: FERC, April 1995, 17720-17721.

transmission customer's monthly peaks, (2) dividing by the average of the transmission provider's monthly system peaks, (3) multiplying by the value of the transmission plant in service, (4) multiplying by a return on equity factor, and (5) dividing by the total number of hours in a year. These tariffs would go into effect at midnight, sixty days after the Commission's final order. All contracts consummated under these tariffs would be permanently binding for their duration, unless explicitly stated otherwise.

The second stage would begin on day sixty-one. "On and after that date, public utilities may propose changes to the rates, terms, and conditions in the generic tariffs... In addition, customers and others may file complaints ... seeking changes in the rates, terms and conditions..."[209]

5.5.1.5 Other Tariff Requirements

The transmission provider would be required to post its available transmission capacity, which is the capacity not already committed to other firm uses during a scheduling period. Acceptable commitments to other uses would include capacity reserved to meet:[210]

- Generally acceptable reliability criteria;
- Current and reasonably forecasted load on the transmission provider's system;
- Current firm power and transmission contracts; and
- Pending firm transmission service requests.

The tariffs would also include minimum notice periods for obtaining service. These should be as short as technically feasible so that users can take advantage of short-term fluctuations in the market.

When purchasing point-to-point service, transmission customers would undoubtedly be required by a tariff to reveal the power receipt and delivery points and energy flows of a transaction. However, a tariff could not require a customer to reveal contractual information or even proof of a contract. While not requiring contractual proof would open the possibility of users reserving capacity and then not using it, the detrimental effects of such actions could be mitigated by either creating a secondary spot market for unused capacity or by including a "use it or lose it" provision in tariffs.[211] Because of the nature of network services, the FERC may allow a transmission provider to garner contractual proof that a prospective customer will use the service.[212]

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[209] FERC, April 1995, 17719.

[210] Ibid., 17686.

[211] The Commission sought comments on the relative benefits/difficulties of these two approaches in the Mega-NOPR.

[212] FERC, April 1995, 17686.

The provisions of the Mega-NOPR would only affect new wholesale contracts; the terms of existing ones would not be abrogated, except possibly with respect to stranded investments.[213]

In the long-term, the FERC believes that the open access Mega-NOPR would alleviate market power in wholesale transactions to the extent that it can reduce its oversight functions. In the industry it envisions, wholesale rates would be market-based, subject to lighthanded FERC regulation.[214]

5.5.1.6 Ancillary Services

In order to support the transmission of electric power and maintain system integrity, there are a number of services that a transmission utility must provide, which are termed ancillary services.

5.5.1.6.1 Definition

The Mega-NOPR defines six ancillary services that should be offered in a utility's transmission tariff:[215]

- Reactive power/Voltage control;
- Loss compensation;
- Scheduling and dispatching;
- Load following;
- System protection; and
- Energy imbalance.

While some ancillary services are best provided by a transmission utility[216] for technical reasons, others could be provided by either a transmission provider or customer. In the case of the latter, customers should be given the option to provide their own ancillary service, purchase it from the transmission utility, or procure it from a third party.[217]

5.5.1.6.2 Ancillary Services Pricing

The Mega-NOPR also defines a rate structure for ancillary service provision during stage one of the rate-making process.[218] The details of this rate structure will be discussed in this thesis in the context of its evaluation.[219]

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[213] See Section 5.5.3.2.
[214] FERC, April 1995, 17688-17689.
[215] Extensive descriptions of these can be found: FERC, April 1995, 17684-17685.
[216] It should be recalled that the Mega-NOPR assumes that transmission would be provided by vertically-integrated utilities, which would retain the capability to produce all ancillary services.
[217] The technical ability of a customer to self-provide/contract out is listed in the more comprehensive discussion of the services. See: FERC, April 1995, 17684-17685.
[218] This pricing structure is established in: FERC, April 1995, 17721.
[219] See Section 10.6.2.

5.5.2 Real-Time Information Networks (RINs)

In order to facilitate the creation of a non-discriminatory transmission network, the FERC issued a Notice of Technical Conference and Request for Comments simultaneous to its promulgation of the Mega-NOPR.[220] The Commission did this because,

> non-discriminatory open access transmission service requires transmission customers to be able to compete effectively with the public utility that owns or controls the transmission. Customers must have simultaneous access to the same information available to the transmission owner. Thus, in this proceeding, the Commission expects to require RINs or other options to ensure that potential and actual transmission service customers receive access to information so that they can obtain service comparable to that provided by transmission owners (or controllers) to themselves.[221]

In its notice, the FERC sought comment on a number of specific questions as well as three broad questions:[222]

- What information should be available on a RIN?;
- What standard formats would be appropriate to use?; and
- What types of information systems are most appropriate to use?

Based upon the Commission's experience in the natural gas industry, it concluded that industry-wide standards for real-time information systems set at the beginning of the process would be the most efficient mechanism for compliance with the Mega-NOPR's open access principles.

5.5.3 Stranded Cost Recovery

5.5.3.1 Basic Principle

When dealing with the issue of open access and the changes it would bring to the wholesale power system, the FERC believes "it is essential to address the transition issues associated with the move toward competition responsibly. The most significant of these issues is stranded cost recovery."[223] The basic principle forwarded by the FERC is that utilities should be permitted to recover "legitimate and verifiable stranded costs associated with requiring open access tariffs."[224]

5.5.3.2 Wholesale Stranded Costs

When stranded costs occur as a result of wholesale requirements contracts being stranded, the FERC maintains that it has authority over their recovery. The FERC would allow the

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220 See FERC, April 1995, 17726-17731.
221 FERC, April 1995, 17727.
222 Ibid., 17729.
223 Ibid., 17669.
224 Ibid., 17664.

recovery of a utility's "stranded wholesale costs"[225] directly from an exiting customer under a limited set of circumstances.[226]

5.5.3.3 Retail Stranded Costs

The FERC further states that retail wheeling stranded cost recovery is best left in the hands of state authorities. Therefore, the FERC would not entertain requests for stranded cost recovery due to retail wheeling unless "the state regulatory authority does not have authority under state law to address stranded costs at the time the retail wheeling is required."[227] The other situation when the FERC would intervene is when a retail customer becomes a wholesale customer (i.e. municipalization). While it would grant to the states the authority to collect retail wheeling stranded costs, the FERC would "not allow states to use the interstate transmission grid as a vehicle for passing through any retail stranded costs."[228]

5.5.4 Separation of Generation, Transmission, and Distribution

5.5.4.1 Ownership

The Mega-NOPR would not require the corporate separation of generation, transmission and distribution functions, but it would require utilities to functionally unbundle transmission from their other activities. In particular, functional unbundling means:[229]

- A public utility must take transmission services (including ancillary services) for all of its new wholesale sales and purchases of energy under the same tariff of general applicability under which others take service;
- A transmission owner must include in its open access tariffs separately stated rates for the transmission and ancillary service components of each transmission service it provides; and
- A public utility must rely upon the same electronic network that its transmission customers rely upon to obtain transmission information about its system when buying or selling power.

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[225]"Wholesale stranded costs" are: "any legitimate, prudent and verifiable cost incurred by a public utility or a transmitting utility to provide service to: (i) a wholesale requirements customer that subsequently becomes, in whole or in part, an unbundled wholesale transmission services customer of such public utility or transmitting utility, or (ii) a retail customer, or a newly created wholesale power sales customer, that subsequently becomes, in whole or in part, an unbundled wholesale transmission services customer of such public utility or transmitting utility." Source: FERC, April 1995, 17701.

[226]These circumstances include contracts consummated before 11 July 1994 that: (i) contain explicit provisions for stranded cost recovery, (ii) do not include explicit restrictions for stranded cost recovery, (iii) are silent on stranded cost recovery and the parties agree to modify the contract or one party files with the FERC for modification, or (iv) include a non-public, transmission utility and the contract is silent with respect to stranded costs. Summarized from: FERC, April 1995, 17701.

[227]FERC, April 1995, 17708. Despite its decision to relinquish jurisdiction, "the Commission holds the strong expectation that states will provide procedures for, and the full recovery of, legitimate and verifiable stranded costs." Source: Ibid., 17691.

[228]FERC, April 1995, 17708.

[229]Summarized from: FERC, April 1995, 17681.

While the FERC would not require corporate unbundling as a result of the Mega-NOPR, it believes that the latter would be accommodated by its functional unbundling decision.[230] Furthermore, the FERC would consider stranded cost cases where a utility chose a corporate unbundling strategy on its own initiative.[231]

5.5.4.2 Jurisdiction

The FERC maintains that it retains jurisdiction over the transmission grid -- "as long as electric energy is being sold to a legitimate wholesale purchaser, we believe the Commission has jurisdiction..."[232] -- even in the case of unbundled transmission sales to retail users.[233] In distinguishing between transmission and distribution functions, the FERC proposal rejects "an absolute bright line" test (although that would be preferable), but rather proposes a "functional line test" with two variants -- one for unbundled wholesale wheeling,[234] and one for unbundled retail wheeling.[235] According to these tests, in almost all cases, electricity flowing to a customer in a restructured industry would pass through both state and federal jurisdiction because the power would cross the FERC regulated transmission system and "in most cases the last public utility in the chain will use facilities that historically were considered local distribution facilities."[236]

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[230]FERC, April 1995, 17681.

[231]Ibid., 17711.

[232]Ibid., 17717.

[233]The Mega-NOPR discusses this at length, see: FERC, April 1995, 17711-17712. This is an interesting situation, given the current political climate. Paul Kemezis comments on the current debate between state commissions and the FERC. "If it did anything, the debate underscored the contradictory and almost bizarre situation facing state regulators. As political power shifts away from Washington to the states, state commissions should be exercising the power they retain under federal law to regulate local utilities with less federal interference -- not more. But the dynamics of electric power industry restructuring, and the physics of electricity, seem to be working against this." Source: Kemezis, 1996, 26.

[234]The test would be: "whether the entity to whom the power is delivered is a lawful wholesaler." All facilities up until the entity receives the power are subject to FERC regulation; while all facilities after reception by the wholesaler are considered state-regulated distribution assets. Source: FERC, April 1995, 17717-17718.

[235]Indicators for determining whether a facility is a wholesale or retail one include:

- Local distribution facilities are normally in close proximity to retail customers;
- Local distribution facilities are primarily radial in character;
- Power flows into local distribution systems, it rarely, if ever, flows out;
- When power enters a local distribution system it is not reconsigned or transported on to some other market.
- Power entering a local distribution system is consumed in a comparatively restricted geographical area;
- Meters are based at the transmission/local distribution interface to measure flows into the local distribution system; and
- Local distribution systems will be of reduced voltage. Source: FERC, April 1995, 17718.

[236]FERC, April 1995, 17717.

5.5.5 Action Since the Mega-NOPR

Just as the California "Blue Book" served as a catalyst for discussion of retail wheeling issues that had been slowly increasing with time, the same has been true for the Mega-NOPR and transmission issues. The Commission has held a number of hearings on transmission related-issues since the Mega-NOPR was issued and it (the Mega-NOPR) has been the subject of lively debate within the industry. Since opening the debate with the Mega-NOPR, the FERC has chosen a deliberative approach, which is in keeping with both the incremental nature of American policy-making and the significant "unknowns" with regard to the best way to handle the deregulation of the electric power system. This strategy and the challenges faced by the FERC were articulated by Commissioner Don Santa,

> Quite candidly, the industry is fooling itself if it expects FERC to play the role of Moses and all at once come down from the mountain with a tablet that contains the 10 commandments that will define the structure of the new power industry. Just as the industry's restructuring is an evolutionary process, so too is the development of the regulation that will be the 'rules of the road' for the restructured industry. The electric power issues facing the FERC and the industry are a moving target in the truest sense.[237]

5.5.5.1 California and Other States

While the FERC takes its time deliberating, California and the other states continue to press ahead. In order to accommodate these states the FERC will soon need to make some decisions. In fact, one of the first tests of the effectiveness of a new FERC policy will be how it is able to handle the issues related to California's restructuring. The CPUC recognizes that a productive state-federal dialogue is important for its ability to restructure the industry and has called for a process market by "cooperative federalism." Let us briefly examine how the CPUC proposals (the May and December preferred decisions) compare with the FERC Mega-NOPR on several significant issues, which can be seen in Table 5.3.

Based upon Table 5.3 it would appear that there is a great deal of congruence between the proposals, and certainly no insurmountable obstacles. The differences that do arise appear to occur because of the difference in nature of the two proposals (the FERC's being wholesale competition and the CPUC's being retail competition).

[237]Source: "Quotable," 20 January 1995.

Table 5.3: The Confluence and Divergence of the CPUC and FERC Models

CPUC POOLCO	CPUC Final	FERC
	Industry Structure	
Disaggregate vertical integration	Disaggregate vertical integration operationally	Disaggregate vertical integration
Functional disaggregation	Functional disaggregation	Functional unbundling
Transmission system independently operated	Transmission system independently operated	Transmission system operated on an open-access basis
Independent system operator with authority over wholesale dispatch; financial bilateral transactions permitted for retail customers	Independent system operator with authority over wholesale dispatch; Power exchange handles competitive auctions; direct retail contracts permitted	Transmission owner accommodates wholesale bilateral power transactions
	Market Structure	
System operator for wholesale pool to provide transparent prices for retail generation	Pool provides transparent prices for generators who participate; other generators can deal directly with customers or aggregators	Generation finds its own wholesale market
Non-discriminatory generator access	Non-discriminatory generator access (regardless of pool/bilateral standing)	Non-discriminatory transmission access
Bundled service from wholesale pool; contracts for differences at retail	Bundled service for those who so choose	Nominally complete unbundling of transmission services
Transparent time-of-day price signaling	Transparent time-of-day price signaling available for all but not mandatory	Power prices set through private bilateral contract
"Contracts for differences" as a surrogate for direct retail contracts -- all financial transactions	Contracts for differences and direct access retail contracts are possible	Direct physical wholesale transactions
Potential to permit direct retail transactions in two years	Retail access in two years for some customers	No provision for retail access

Sources: Hollis and Teichler, 1995, 24; and author.

5.5.5.2 Real Time Information Notice of Proposed Rulemaking

In December 1995 the FERC issued a notice of proposed rulemaking which selected the Internet's World-Wide Web graphical interface as the vehicle over which RINs would be developed.[238] This NOPR was the culmination of significant effort on the part of the industry and the Commission. Following a number of technical conferences, two committees with inclusive membership were established: one to answer the "what"

[238] Source: "'Web' Is Choice in FERC's RIN."

questions (what information should be available) and other to answer the "how" questions (technical specifications for RIN hardware and information presentation). The issues and discussion are interesting, however, they are marginally relevant to this thesis so they will not be discussed in further detail here.[239] Although a proposed rulemaking, based largely upon the findings of these committees, is now in place, the FERC has a long list of questions that must still be answered. It is expected that the FERC will make its final rulemaking on both RINs and Open Access sometime this spring.[240]

5.5.6 The Future

In attempting to create an open access transmission system, the FERC is looking at the creation several types of organizations to help further its goal.

5.5.6.1 Independent System Operators

The FERC is intrigued with independent system operators as vehicles for ensuring compliance with its open access requirements. In particular, "the Commission is interested in whether ISOs are necessary to ensure comparability for public utilities that are not members of power pools."[241] In announcing a January 1996 technical conference on the topic, the FERC cited three reasons (for the conference):[242]

- To help define the essential elements and operational characteristics of an ISO;
- To examine the principles of power pools; and
- To develop criteria for evaluating the ISO proposals that are currently being developed.

Clearly, the FERC's ultimate decision on the ISO issue will have large implications for state-level decisions. On one hand, if it were to determine that ISOs do not meet Federal Power Act standards for not being unduly discriminatory, the FERC would essentially unravel all of the work in California and Wisconsin. On the other hand, if the FERC were to determine that all transmission systems must be run by an ISO, it would probably speed the deregulation process in other states.

5.5.6.2 Regional Transmission Groups

Regional Transmission Groups (RTGs) are another concept that the FERC is dedicated to in the process of restructuring the electric power industry. The purposes of RTGs are to:

- Speed the development of competitive markets;
- Increase the efficiency of the operation of transmission systems;
- Provide a framework for coordination of regional planning of the system; and
- Reduce the administrative burden on the Commission and members of RTGs through voluntary dispute resolution.

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[239] To read this NOPR, see: FERC, December 1995.
[240] Source: "'Web' Is Choice in FERC's RIN."
[241] FERC, January 1996, 706.
[242] Source: "FERC Goes to Work on ISOs."

While RTGs are given brief mention in this thesis, they are an important part of FERC's efforts. Three such entities have been formed and several others in the wings. In an open access era, the FERC views RTGs as important for regional capacity planning (as opposed to system-by system planning), dispute resolution, and for serving as "regional laboratories" for experimenting with innovative transmission policies.[243]

5.6 THE PROPOSALS THAT WILL BE EVALUATED

Having discussed many proposals in varying degrees of depth, we will now choose five to evaluate in Chapter 9. Two criteria will be used in selecting the five. The first is relevance: what is the likelihood that the proposal will be adopted? Is it under serious consideration anywhere? If not, might it be at some point in time? The second criterion is uniqueness: is the proposal sufficiently different from the others that it might illustrate differences or lead to different implications for the transmission system?

With these two criteria in mind, the first three come from the California debate: POOLCO, Bilateral and the "final" models. The over-riding reason for their selection is that these were the three proposals being considered by the largest state in the country for restructuring its electric power industry. Not only is California the largest state, but with its ultimate selection of a hybrid model, it was the first state to take such a radical step in restructuring its industry.

The fourth proposal comes from Wisconsin: the "plausible extreme" model. This is chosen because it represents an extreme that may become reality at some point in time. Furthermore, it is quite different than the three under consideration in California. Thus, the evaluation of it holds the potential for finding significantly different results than the relatively more similar California proposals.

The final "model" that will be examined is the FERC Mega-NOPR.[244] This proposal is different in character from the others, as it is not a comprehensive model for industry restructuring, but rather a template for the nation-wide debate. It is in many ways the most

[243]FERC, April 1995, 17689.

[244]This is not a comprehensive industry model; but rather, it is a significant policy that will impact all comprehensive models. Because this policy will be significant (and will have implications for the future efficiency of the grid and for the prospects of non-utility transmission systems) this will be evaluated along with the other four models.

important of all the models for the purposes of this thesis, as it will determine the basic transmission structure that will have to be used in all of the state restructuring proposals.

We will return to these proposals in Chapter 10, where they are evaluated for their economic efficiency in transmission. Having now discussed the basics of some restructuring proposals, let us change our focus and develop criteria for evaluating them. We begin the discussion in Part II of the thesis by attempting to learn efficiency lessons from the deregulation of the natural gas and telephone industries.

PART II:

ESTABLISHING EVALUATION CRITERA

Chapter 6
Deregulation in Related Industries

The post-636 world will provide us and our customers with more options. But it is somewhat akin to a situation if the automobile manufacturers were to tell us they are providing us with more options by sending us all the parts for a car in a box. We then can 'bundle' the parts any way we want. And, indeed, we can. The key is how to make it work. It will be a challenge.[1]
-- *Daniel A. Bollom, President and CEO of Wisconsin Public Service Corp. (1992)*

6.1 INTRODUCTION

6.1.1 Deregulation in Other Industries

While they are new to the electric power industry, the deregulatory[2] forces being unleashed in the industry have been changing the structures of relatively stable American industries for nearly two decades. Since 1978, when the airline industry was the first to experience the process, nine industries, accounting for more than $600 billion in annual output,[3] have been freed, to varying degrees, from government control over firm entry and exit and price setting. During this period, Presidential Administrations from both parties have advocated that markets are better equipped than bureaucrats to set the entry conditions for firms and the prices they charge in an efficient manner.[4] The result of deregulation has been increased economic efficiency through a process of significant economic tumult.[5] Seemingly-invincible companies, such as Pan-American Airlines[6], have gone bankrupt, others have greatly cut back -- once-secure jobs have been lost forever -- while entrepreneurial firms have arisen, creating new jobs.[7] While this has been disruptive to the industries affected, deregulation has repeatedly given consumers a greater range of choice in products and services that are typically less expensive.[8]

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[1] Source: "1992 Gas Utility Executive's Forum", 68.
[2] For the purposes of this discussion, deregulation will be interpreted as: "the state's withdrawal of its legal powers to direct the economic conduct (pricing, entry, and exit) of nongovernmental bodies. See: Winston, 1993, 1263; and Stigler, 1981.
[3] Winston, 1993, 1263, 1265.
[4] For example see an editorial which ends with: "there is really nobody left who believes that the [integrated and regulated telephone] system is the answer." Source: Warsh, 1995.
[5] For economic data, see: Winston, 1993.
[6] For an detailed account of Pan-Am's failure, see: Gandt, 1995.
[7] Overall, there have been small to significant losses in total jobs and employment. Source: Winston, 1993, 1282.
[8] See: Winston, 1993; and Gardner and Gilson, 1994.

6.1.2 Electric Power Deregulation

The expectation that deregulation would bring less expensive rates to the electric power industry is the main impetus for the deregulation movement. This motivation has been made explicit by the regulatory bodies in the two states leading the deregulation charge -- California and Massachusetts. The latter's Department of Public Utilities stated, "reducing costs, over time, for all consumers of electricity is the primary objective of the Department's efforts in restructuring the electric industry."[9]

6.1.3 Ability to Learn From Others

While from a technical standpoint the deregulation of the electric power industry is probably more complicated than any of the industries that have undergone deregulation to date, it does have the benefit of being able to learn from its predecessors' successes and mistakes. Economic historian Peter Temin argues that while the path to deregulation cannot be predicted based upon what has happened in other industries, lessons nevertheless can be learned -- "history does not repeat itself. But history does have echoes."[10] With that in mind, this chapter will be devoted to an examination of deregulation in the telephone industry (specifically the events leading up to the break-up of AT&T) and in the natural gas industry[11]. The stories recounted in this chapter are not intended to be authoritative historical accounts;[12] rather they will focus upon particular lessons that are applicable to electric power industry deregulation.

6.2 DEREGULATION AND BREAK-UP OF THE AT&T TELEPHONE SYSTEM

6.2.1 The Context

One of the most visible manifestations of deregulation, which directly touched the life of nearly every American, was that which transformed the telephone industry in the 1980s. Under the terms of the Modified Final Judgment (MFJ) negotiated between AT&T and the U.S. Department of Justice, under the jurisdiction of Judge Harold Greene, the telephone company was broken up into a new AT&T and seven regional Bell operating companies (RBOCs or "Baby Bells.") The events that led to the break-up of what was then the world's largest corporation (and that in the previous year had recorded the largest profits of

[9] Massachusetts Department of Public Utilities, 16 August 1995, 1.
[10] Temin, 1994, 10.
[11] These two industries were chosen for several reasons, which will be made clear in their respective sections.
[12] The former has been the source of many excellent books, while the latter has attracted less attention, but has been the topic of several recent Ph.D. theses.

any company ever)[13] is fascinating and has been the subject of much debate. In the literature on the causes of the break-up, two primary schools of thought have emerged One holds that technological change was the driving force for the break-up[14]. Vietor argues, for example, that:

> By comparison to any other national [telephone] network, there is no question that this American [regulated] system worked best -- measured by penetration, technical quality, or price. But of course this regulatory structure was rooted in analog electronics. By the mid-1970s the digital revolution, triggered by AT&T's own invention of the transistor, was radically changing the product and operating economics of the telecommunications business. And as these economics changed, the existing regulation became less and less appropriate.[15]

The second school of thought holds that the break-up was the result of "pricing and politics"[16] -- incremental decisions that, when taken together, undermined the old system and made it ripe for newcomers. One example is the Federal Communications Commission (FCC) decision that allowed MCI into the industry. The intent of the original decision was to allow off-system alternatives to AT&T's service, to have the giant monopoly feel the discipline of the market in a niche market or two. Instead, the original and subsequent decisions allowed MCI to serve the most desirable customers ("cream-skim"), while leaving system responsibility and the less desirable customers to AT&T. The FCC also essentially prohibited AT&T from being able to compete with MCI, by forcing it to charge embedded, local service-subsidizing rates to the same customers that MCI was allowed to charge marginal cost-based rates. Those in the second school of thought would argue that while technological change was an enabler of more competition, it did not predestine competition. Rather, regulatory decisions that ignored and thus furthered the inefficiencies of the existing regulatory structure (especially the cross-subsidies), and which ignored the systemic nature of the telephone industry, drove the industry deregulation. Instead of turning to deregulation, a continued reliance on the monopoly system could have incorporated these new technologies while retaining the benefits of a national system, benefits that were partially lost when the Bell System was splintered.

Both schools of thought believe that the break-up was at least partially motivated by a desire to speed technological development. Some analysts in the 1970s and early 1980s felt that through its monopoly status, AT&T was hindering the adoption of new

[13] Source: "AT&T Move is a Reversal of Course Set in 1980s."
[14] See Piepmeier *et al.*
[15] Vietor, 1994, 233.
[16] See Temin, 1987.

technologies -- from consumer gadgets such as answering machines to revolutionary advances such as satellite systems. Therefore, in order to let the satellite era begin, and to allow for more services to consumers, the monopoly needed to be broken up.

With this as a background, we next examine the history of the telephone industry.

6.2.2 The Early Bell System

The modern telephone system has its roots in the work of Alexander Graham Bell, who invented the telephone in 1876. When Bell's patents (which in the mid-1880s became the property of AT&T) expired, competition in the industry quickly emerged both in equipment and phone service. This competitive environment did not last long, however, as AT&T began to acquire many of its competitors, including the leader in the telegraph communications era, Western Union. This anticompetitive behavior was much to the chagrin of the Justice Department, which began an anti-trust investigation. Many of AT&T'S acquisitions occurred during the leadership of Theodore Vail, who became chairman in 1907. Vail's vision for the telephone industry was universal service (provided by AT&T). In 1913 AT&T reached an agreement with the Justice Department which required it to sell Western Union (and agree to stay out of the telegraph business) in return for the fulfillment of Vail's aspiration -- status as a regulated monopoly. AT&T's philosophy with regard to the benefits of universal service and its belief in the need for a regulated private monopoly to provide it was laid out in its 1910 Annual report.

> It is believed that the telephone system should be universal, interdependent and intercommunicating, affording opportunity for any subscriber of any exchange to communicate with any other subscriber of any other exchange within the limits of speaking distance, giving to every subscriber possible additional facility for *annihilating time or distance by use of electrical transmission of intelligence or personal communication.* It is believed that some sort of a connection with the telephone system should be within the reach of all... It is believed further, that the idea of universality can be broadened and applied to a *universal wire system for the electric transmission of intelligence (written or personal communication)*, from every one in every place to every one in every other place, a system as universal and extensive as the highway system of the country which extends from every man's door to every other man's door...
>
> ... It is believed that all this can be accomplished to the reasonable satisfaction of the public with its acquiescence, under such control and regulation as will afford the public much better service at less cost than any competition or government-owned monopoly could permanently afford and at the same time be self-sustaining.[17] (emphasis original)

[17] American Telephone and Telegraph, 1910, 22-23.

This set of beliefs would guide AT&T for the next 70 years, and from 1913 on, the company embraced government regulation as the mechanism through which it could provide its goal of universal service and end-to-end responsibility for the network. Following a wave of purchases of small phone companies, by the late 1920s AT&T held 79% of the local exchange market.[18] During the Great Depression, when the oil, steel, and electric power trusts were broken up, AT&T was successfully able to argue its case as a public servant, and for the next 50 years it largely retained its "motherly" stature as a quasi-public servant. That is not to say that problems did not arise on occasion. One of these occurred in 1949, when the U.S. Justice Department filed an anti-trust suit against AT&T. The suit sought the divestiture of Western Electric (AT&T's manufacturing subsidiary) from Ma Bell. The case was dropped in 1956 when AT&T signed a consent decree by which Western Electric remained part of AT&T, in return for which, AT&T and Western Electric agreed not to enter other industries, such as the computer industry.[19] This agreement cemented the integrated structure of the phone system. AT&T had exclusive control over the long distance "long lines," and was dominant in local phone service, through its local Bell operating companies, and in the equipment manufacturing market, through its Western Electric subsidiary.

6.2.3 The Monopoly is Challenged

Though AT&T's future seemed secure in the mid-1960s, a combination of events over the next decade and a half would lead to the break up of the Bell System.

6.2.3.1 The Challengers and the FCC

In the late 1960s and early 1970s, a series of Federal Communications Commission (FCC) rulings[20] would begin to transform the telephone industry.[21] During this period, the chief of the FCC's Common Carrier Bureau was Bernard Strassburg. While his goal was not to create a fully competitive industry, Strassburg saw benefits in forcing limited competition on the Bell System.[22]

6.2.3.1.1 The Carterphone

The first set of FCC rulings had to do with equipment on the telephone system. Prior to 1969, only devices provided by the telephone company could be attached to the phone

[18] Vietor, 1994, 173.
[19] Shepard, 1971, 100.
[20] Which were decided by close FCC votes.
[21] Temin, 1987, 68.
[22] Ibid., 1987, 78.

system.[23] Whenever others proposed a device for use on the system, they were opposed by AT&T. The basis for the opposition was a claim that the system would face a serious technical threat if non-Western Electric equipment were used.[24] While this reaction was often interpreted outside of the company as a monopolist's attempt to protect its turf -- and to some extent it probably was -- it also reflected a deeply held conviction by many engineers within the company regarding the importance of protecting the integrity of the network.[25] It was an extension of Bell's long-established cultural value of responsibility for the provision of end-to-end service.

The first of the equipment rulings was the Carterphone decision. This device was a primitive mobile phone developed by a Texas entrepreneur, Tom Carter. Despite AT&T's strenuous objections, the FCC voted 4-3 to allow Carterphones to be connected to the network. While as a product the Carterphone itself was not significant, the result of the case it spawned was to set a precedent for non-Western Electric equipment to enter the system. Although Strassburg maintains that the intent of the decision was to allow for additional equipment rather than replacement of existing Western Electric equipment, it did in fact have the latter effect.[26]

AT&T's response to this decision was to require a "protective coupling arrangement" (PCA) to be placed on any non-Western Electric equipment. This irritated many people because AT&T charged a $2 monthly fee for PCAs.[27] To those skeptical of AT&T's motives, this was further proof that the company did not have system reliability on its mind, only protection of its monopoly. Several years later, in 1972, the PCAs gave way to certificates of compliance, which were given to equipment that met detailed technical standards.

6.2.3.1.2 MCI

With competition having breached the equipment part of the system, the next beach head was telephone service itself. In Temin's view, the markets for long distance service were opened as a consequence of the industry's pricing structure. Long distance phone calls can

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[23] Martin, 1977, 362.
[24] A similar argument was made by the natural gas industry, with respect to "alien" gas, and by the electric power industry, with regard to IPPs, in the early 1980s. Sources: O'Neill and Whitmore, 1995, 72; Fyock, 1988, 78-79.
[25] Bambenek, 1995.
[26] Henck and Strassburg, 1988, 127.
[27] Ibid., 1988, 130.

be charged in many ways.[28] Two alternatives are station-to-station and board-to-board rates. When charging on a station-to-station basis, the long distance call (for billing purposes) consists of the use of the phone system from the originator's station (telephone) to the other person's station (his/her telephone). Therefore, the toll charge includes not only the transmission between the city central stations, but also the connection to the city's central station on both ends. During a local call, this latter service is provided free-of-charge to the customer. The result is that station-to-station rate structures subsidize local service.[29] A second option is board-to-board rates. By this rate system, the "local" part of the call is free, all that the caller pays for is the "long distance" segment of the call, the transmission from one central station to the other. In a series of decisions which began during World War II with the establishment of station-to-station rates, and which ended in the 1970s, the subsidization of local service by long distance service gradually increased. Especially during the 1940s and 1950s, these cross-subsidies probably seemed innocuous since the telephone system operated as one system. While these decisions were intentional, they caused economic distortions and their purpose was not understood by all participants at key junctures in the deregulation process.

The rising subsidies caused a significant (and increasing) gap between the marginal cost of a long distance call and the price that was charged for it. This gap allowed start-up companies, such as Microwave Communications Inc. (MCI), to enter into the long distance business. Permission was granted by the FCC, which was seeking "limited" competition in the telephone industry. MCI could profitably connect high service density city-pairs, such as the Chicago-St. Louis corridor, at prices 65% below those of AT&T.[30] When AT&T sought to match or beat these prices (which on a marginal cost basis it could do), it was sharply criticized for monopolistic practices. Initially, the FCC granted MCI permission for private line service between St. Louis and Chicago on an experimental basis. However, this decision opened the floodgates and after numerous requests for private line service (many of them from MCI and its affiliates) were granted in the ensuing several years, the FCC granted blanket permission for specialized services. A later decision, in 1974, mandated that these "private line" services be connected to the Bell System's switching network. With that decision, AT&T essentially faced true competition

[28] In economics there is no "correct" way to allocate the joint costs of local plant to different uses, especially since a major part of the expenses is not traffic sensitive. Source: Temin, 1987, 24.
[29] Subsidization occurs because the "extra" revenue from long distance calls is used to pay for the operation of the local phone system, which, in turn, reduces the total amount that must be collected from local ratepayers. This is especially helpful (in terms of subsidization) since much of the cost of a telephone call goes toward fixed costs.
[30] Vietor, 1994, 201.

in long distance service. In 1978 the so-called EFINA tariffs were developed by which the new long distance companies would pay 35% of what AT&T would pay to the local telephone companies for their long distance connections to the switching stations.[31] Because of these decisions, AT&T's competition in long distance, though small in relative volume, had gained a firm footing.

6.2.3.1.3 The people

In McGowan, MCI's CEO, AT&T had encountered an entrepreneurial pit-bull. As Temin describes him, "McGowan was a street fighter, a man who took advantages when they appeared and seldom worried about the rules of combat."[32] McGowan's personality and tenacity did much to expand the envelope of competition in the industry. McGowan was not alone in his attack on AT&T's monopoly, however. He was joined by a group of "policy entrepreneurs." As was mentioned previously, in the late 1960s and early 1970s McGowan had benefited from Bernard Strassburg's tenure as chairman of the FCC committee that regulated AT&T. Yet another key figure was Attorney General William Saxbe, who initiated the fateful antitrust case, apparently without the support of the Ford Administration. As will be seen later, the assignment of Judge Harold Greene to the anti-trust case in mid-stream was also important. His rapid handling of the case and the perception that he would be willing to take drastic actions if he found them appropriate put pressure on AT&T to settle.[33] The man who would eventually break the monopoly, Assistant Attorney General William Baxter, also played a key role. Baxter overcame objections from the Reagan Cabinet, and even the President himself, and managed to continue with the case. President Reagan reportedly commented that when he was a boy, it cost $.02 to send a letter across the country and $2 to make such a phone call. Today, it costs $.20 for each. If the phone company can deliver such efficiency, why fix something that is not broke? However, neither the President nor anyone else above Baxter explicitly forbade him from pursuing the case, and he persevered.[34] AT&T's position was also not helped by the abrasive style of Chairman John deButts, who challenge to the regulators in the early 1970s helped to bring on the antitrust case. His style also helped create a perception of recalcitrance on the part of AT&T that contributed to the decline in support for the company during the 1970s.

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[31] Henck and Strassburg, 1988, 181.
[32] Temin, 1987, 47-49.
[33] For a retrospective look at Judge Green's contributions, see: "Telecom Czar Frets Over New Industry Rules."
[34] Temin, 1987, 229-230.

6.2.3.2 AT&T and Its "Drag" on Technology Adoption

At the time that the antitrust case was being formulated, there was a widespread belief that microwave technology would be the technology of the future. Many in the communications field were concerned that AT&T was dragging its feet in installing the new technology, thus causing economic inefficiency. James Martin argued, for example, that "the worst aspect of the rate-of-return regulation is that it tends to discourage projects which could bring a massive saving in capital equipment costs, as could the use of large telephone company satellites today."[35] Many felt that while the wire cable telephone system of the past had clear network properties, satellite technology, which was not constrained by immobile conduits, would diminish the network nature of the system, and with it, the efficiency advantages of a single national telephone system.

More generally, critics of AT&T were concerned about its slow adoption of new technology. In some respects, this was a natural product of the Bell System culture, which viewed telephone service quality, and the technical integrity of its system, as its highest priorities. For example, soon after he became chairman, John deButts announced that the quality of POTS (plain old telephone service) was the System's most important objective.[36] Predictably, the result of this focus was that "customer demand assumed a relatively minor role in service development or introduction."[37] Bell System engineers were disposed to standardize technological improvements and slowly make them available throughout the system in order to guarantee reliability.[38] The same mind-set pervaded AT&T's equipment manufacturing unit, Western Electric.

Many outside the system concluded[39] that new technologies were being stymied in the domestic equipment business.[40] One important example was an influential 1971 article by William G. Shepard that contained seven hypotheses about the negative impact of the Bell

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[35] Martin, 1977, 360.
[36] Coll, 1986, 7.
[37] Bolter and McConnaughey, 1991, 285.
[38] Nevertheless, as Temin notes: "The Bell System worked spectacularly well. Telephone service became progressively cheaper, more available, and more automatic... Much of the solid state electronic technology that transformed telephony into telecommunications came out of Bell Labs and was implemented first by the Bell System. This record of relentless technological improvement was the glue that held together AT&T's various accommodations with the state and federal governments." Source: Temin, 1987, 19.
[39] For example, see: Shepard, 108.
[40] Although competitors did have non-Bell outlets in the 20% of local service which was provided by the likes of GTE and United Telephone.

System's monopoly on performance and innovation. These were:[41]

- Classical monopoly restraint;
- X-Efficiency;
- Rate-base preference and capital intensity;
- Innovation stopped by market closure;
- Exclusivity of technology;
- Preemptive innovation in response to competition; and
- Entry into unprofitable markets.

While these hypotheses were unproven, Shepard's case was persuasive to many.

6.2.3.3 The Anti-Trust Suit

The Justice Department staff, which had long been concerned with the AT&T situation,[42] saw an opportunity for action amidst the disarray of the post-Watergate Ford White House. In November 1974, only 3 months after Richard Nixon's resignation, the Justice Department announced that it was bringing an antitrust suit against AT&T. This suit was widely unanticipated and does not appear to have had the support of the Ford Administration.[43] During the Carter years the suit slowly dragged on, although the Administration gave it little attention. Several attempts by AT&T to have the case dismissed were unsuccessful. One of the most significant developments in the case was the change of judges in 1978. The first judge assigned to the case, Joseph Waddy, developed a terminal illness. The case was then placed on the docket of Judge Harold Greene, who had drafted the 1964 Civil Rights Act and the 1965 Voting Rights Act. Once the case was in Greene's court, the suit picked up speed.[44] Five days after the trial began in January 1981, the Reagan Administration took office, and responsibility for the Justice Department's case was given to the tenacious William Baxter. Although Baxter was a third-tier administration official, his two superiors had conflicts of interest in the case, so he was able to act with the full authority of the Justice Department, even though many high Administration officials opposed the case. Despite this sentiment, having never been formally enjoined from continuing the case, he litigated it, in his words, "to its eyeballs"[45] until AT&T's signed the decree.

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[41] Shepard, 1971, 101-117.
[42] Temin, 1987, 101.
[43] Temin, 1987, 110.
[44] In comparison, while the IBM court case took 7 years to settle, the much more complicated AT&T case took only 1 1/2 years of court time, largely due to Judge Greene's expediency. Source: "What a Difference a Judge Makes."
[45] Cited in: Vietor, 1994, 210.

6.2.3.4 AT&T's Response

By the 1970s, AT&T had developed a special place in American society, as "a private enterprise with a public trust."[46] As its position was beginning to be undermined in 1973, John deButts, the new chairman of AT&T, gave a bold speech at a meeting of the National Association of Regulatory Utility Commissioners (NARUC), entitled "An Unusual Commitment." The speech's purpose was, in deButts' words, "to take to the public the case for the common carrier principle."[47] While the speech clearly signaled AT&T's commitment to Vail's ethos, it was taken by some in the Justice Department and at the FCC as a clear challenge.

Following the filing of the anti-trust suit, AT&T attempted an end-run around the Justice Department and the FCC. It gathered wide Congressional support for the Consumer Communications Act of 1976, commonly referred to as the "Bell Bill," which would have solidified the existing regulatory structure. But despite having nearly 200 co-sponsors the bill never made it out of the House Subcommittee on Communications. Attempts in 1977 and 1978 to resuscitate it failed as well, and by that point in time the momentum for deregulation was beginning to build in Congress.

In 1979 Charles L. Brown took over as chairman of AT&T. Under the leadership of Chairman Brown the company moved gradually toward a more conciliatory position with regard to competition. deButts' contentious style had not helped, and perhaps even hurt, and by 1979 AT&T found itself in a precarious position: its hopes for legislation in Congress were virtually dead, the anti-trust suit was progressing, and a full-scale certification process for non-Western Electric Equipment became operational in 1978. Faced with these obstacles, Brown saw little choice but to become more conciliatory. His stance was called "a new realism." In January 1982, less than three years into his chairmanship, Brown agreed to the Modified Final Judgment (MFJ) of the 1956 Consent Decree with the Justice Department.[48]

[46] Tunstall, 1985, 2.
[47] deButts' speech cited in Temin, 1987, 96.
[48] On the same day, 8 January 1982, the Justice Department dropped its long-standing anti-trust suit against IBM.

6.2.4 The Monopoly is Broken Up

6.2.4.1 The Deal is Made

The MFJ mandated the divestiture of AT&T's local phone companies, which accounted for 80% of its assets.[49] AT&T's agreement to the MFJ was motivated by legal and economic considerations. In the legal realm, Judge Green had consistently been ruling against AT&T on procedural issues. There was no way to predict how he would decide the case and signing the decree eliminated the risk of an even more damaging judicial decision. The MFJ also unshackled AT&T from the restraints of its 1956 agreement. allowing it to become an active participant in the electronics revolution.[50] It also allowed the company to fight off competitors on its own turf with less fear of government reprisal. As Brown stated, "we were surrounded by a fence with a one-way hole in it. Competitors could come in, but we could not get out into their unregulated markets."[51]

6.2.4.2 Unanticipated Technology Used

Following the break-up, a number of new competitors entered the long-distance market, with MCI and U.S. Sprint emerging as AT&T's two leading competitors. Against expectations that telecommunications satellites would make long distance provision less systemic and more distributed, MCI and Sprint, in fact, poured billions of dollars into fiber optic cable systems. Between 1985 and 1989, nearly 60,000 route miles of fiber optic cable were laid by Sprint, MCI and AT&T.[52] Instead of creating a number of dispersed long-distance "systems," the result of divestiture was the creation of three competing systems that were much more systemic in nature than expected.

6.2.4.3 Mixed Public Reaction to the Divestiture

While consumers have enjoyed the benefits of a 60% decline in long-distance rates[53] since 1984, they have also experienced increased responsibilities with regard to telephone service. What once was simple -- receiving telephone service from one company, using a phone provided by Ma Bell, and paying one monthly bill -- had become more complicated. Choices abounded, from the selection of telephone equipment to the selection of a long distance provider. The new long distance companies brought with them marketing gimmicks, massive advertising, and telemarketers peddling telephone service. Customers had to pay more than one monthly bill, and the new choices brought new obligations. As a

[49] Source: "Life After Litigation at IBM and AT&T," 61.
[50] At the time, in particular, AT&T was interested in entering the computer business.
[51] Source: "Life After Litigation at IBM and AT&T," 59.
[52] Sirbu, 1991, 336.
[53] Source: "Ready, Willing, Cable."

result, for many years American public opinion remained mixed with regard to the break-up. For example, in a 1986 poll, only 52% of Americans said that they supported it.[54]

6.2.4.4 The Decline of Bell Labs

A casualty in the deregulation process has been Bell Labs. When the MFJ was signed in 1982, Bell Labs was the largest research organization in the U.S., having 25,000 employees and a budget of $2 billion.[55] The comfortable profits AT&T made through its regulated monopoly position were poured into Bell Labs[56] to build a better system. As a result of this effort, "it [AT&T] was regarded, domestically and abroad, as operating a model telephone system."[57] Bell Labs also made many discoveries that had broad applications outside of the telecommunications industry, such as the laser and transistor. Because of the 1956 consent decree, there was relatively open diffusion of Bell Labs' inventions, which made it a quasi-public research facility. The 1982 MFJ made Bell Labs more inward-looking, with more emphasis on shorter-term and more focused research[58] (as opposed to basic scientific research).[59] The recent announcement of AT&T's second break-up threatens to weaken Bell Labs further, as the Labs too will be split -- between the "new" AT&T telecommunications company and Lucent, the manufacturing spin-off (which will receive most of Bell Labs' facilities and employees). It is expected that the trend away from scientific research will continue, and perhaps be accelerated by the second break-up.[60]

Another casualty of the increasingly competitive environment is Bellcore, the $1 billion per year research consortium of the "Baby Bells" that was established after the divestiture for engineering, research and administrative purposes[61] such as standards creation. In April 1995 the Baby Bells decided that they would sell this enterprise. The underlying cause of the sale is the growth in competition in the industry.[62] Immediately after divestiture the Baby Bells had similar needs, but the strategic paths of the companies have diverged with time,[63] and as they approach head-to-head competition, they have been less willing to share technological advances.[64] As a Bellcore spokesman observed, "collaborative research and

[54] 1986 Roper poll cited in: Winston, 1993, 1284.
[55] Mowery, 1988, 355.
[56] Vietor, 1994, 319.
[57] Henck, 1988, x.
[58] Source: "Most Employees of Bell Labs Will Join Equipment Business."
[59] Source: "Prized Labs Shifts to More Mundane Tasks."
[60] Sources: "Bell Labs Faces Mundane Future Under Breakup Plan;" and Chapman, October 1995.
[61] Source: "Sale May Break Up Bellcore," 19.
[62] Source: "Breaking from Tradition."
[63] Source: "Psst! Want to Buy a Research Lab? The Baby Bells Want Out."
[64] Source: "Baby Bells Expected to Announce Plans for Sale of Their Bellcore Research Lab."

development does not blend well into a landscape of companies that are preparing to do battle with one another as long-distance markets open up."[65] But it remains unclear who will buy Bellcore, and what purpose it will serve. The expectation is that the Baby Bells will continue to rely on Bellcore for R&D,[66] but a similar dependence on Bell Labs was expected following divestiture[67] and it was because such a cooperative reliance did not develop that Bellcore expanded its research and development functions.

6.2.4.5 Recent Developments

During the dozen years that have now ensued since the break up, the telephone and the larger telecommunications industry, have become one of the most exciting and expanding industries (see Table 6.1). Recently, the "information superhighway" and the Internet have captured the imagination of scientists, citizens, and businesses alike. Cellular phones and fax machines have changed the way business is done. Cellular phones, like communications satellites in the 1970s, hold promise for fundamentally changing the nature of the telephone industry, this time in the local service segment.

Table 6.1: The Telecom World: Then and Now

Year	1984	1994
Millions of calls handled by AT&T during a typical business day	37.5	185
Number of AT&T employees	373,000	304,500
AT&T's share of long-distance market	88.3%	57.5%
Number of long-distance carriers	1 + several minor rivals	~500
Number of phone numbers (in millions)	111.4	155.8
Cost of 5-minute call between New York and Los Angeles	$1.40	$2.70
Wholesale cellular phone sales (in millions of $)	Negligible	1,275
Wholesale fax machine sales (in millions of $)	Negligible	964

Source: "AT&T Move is a Reversal of Course Set in 1980s."

The past year has been especially interesting. In September 1995 the business world was surprised by the announcement of the "second" break-up of AT&T.[68] The company decided that in order to stay a leading player in the new world order of the telecommunications industry it would be desirable to split into three separate parts:

[65] Source: "Sale May Break Up Bellcore", 19.
[66] Source: "Breaking from Tradition," 16.
[67] Mowery, 1983, 37.
[68] For example, see: "AT&T Will Split into 3 Companies;" "AT&T, Reversing Strategy, Announces a Plan to Split into 3 Separate Companies;" Defying Merger Trend, AT&T Plans to Split Into Three Companies;" and related stories.

telecommunications, telecommunications equipment, and computers. During 1995 and early 1996, the Congress continued its decade-long attempt[69] to reform the nation's communications laws, and in the process, radically alter the competitive landscape of the industry.[70] Finally, on 8 February 1996, the telecommunications industry entered a new era when President Clinton signed into law a bill which essentially rewrote the Communications Act of 1934, which has shaped the industry since the Great Depression. Of particular interest to the telephone industry are provisions which would allow long-distance companies to provide local service and local companies to provide long-distance service once they prove their local phone markets have been opened to rivals. The law would also allow cable and telephone companies to compete in each other's markets and would allow for mergers between cable companies and the Baby Bells.[71]

6.2.5 Lessons

Many lessons can be learned from such a complicated and fascinating story. However, given the focus of the thesis, five lessons will be taken from the telephone case.

6.2.5.1 Technological Advance is Both Important and Unpredictable

Neither of the two "sides" in the historians' debate on the cause of the fall of the Bell System dispute the fact that changing technology played a role. It is only the relative importance of this role that is contested. A clear lesson from the events is that technological advance is unpredictable. It was believed that communication satellites would be the next important technology in long-distance telephone transmission, and the decision to break up the Bell System was partly based on that premise. Yet, as Temin observes,

> to the extent the Bell System was broken up to usher in the age of microwave radio, the government forced a permanent shift in the industry's structure to take advantage of a temporary technical opportunity -- which has already been superseded for high-density uses.[72]

Rosenberg concludes from his study of the telecommunications industry that, "regulators should not pretend to be able to predict the future level of systemness or the viability of a specific technology in something as complex as the telephone network."[73] Therefore, any

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[69] For example, see: "A 'Camelot Moment' on Communications;" and "An Accord Struck on Communication Faces House Snag."

[70] For example, see: "Senate Approves Far-Reaching Bill on Media Industry;" "Senate, in 81-18 Vote, Clears Overhaul of the Nation's Communications Laws;" and "Ready, Willing, Cable."

[71] Baby Bells could also merge with each other. Sources: "Telecom Vote Signals Competitive Free-for-All;" "Communications Bill Signed, And the Battles Begin Anew;" "Congress Votes to Reshape Communications Industry, Ending a 4-Year Struggle;" and "Washington's Wake-Up Call."

[72] Temin, 1987, 347.

[73] Rosenberg, 1994, 228.

regulatory system should be somewhat robust to technological change and not be designed solely with reference to specific technological predictions.

6.2.5.2 The Pricing Structure Matters

The second lesson is that pricing structures and seemingly insignificant regulatory actions can make a big difference. As Temin notes, "arcane as these theories [board-to-board vs. station-to-station] may seem to be, they were at the heart of the telecommunications policy debates in the 1970s and 1980s."[74] Similar phenomena have been noted in other industries. "Yawn-inducing federal decisions about standards for electronic devices and the availability of the broadcast spectrum for commercial use indirectly dictate the rate and results of electronic device development."[75] In the case of the telephone system, the decision to subsidize local service by long distance service, through station-to-station billing, created an incentive for companies such as MCI to steal away high volume customers by charging them the marginal cost of service. These low prices, in turn, made AT&T look like a bloated monopolist. What was not realized by many was that the subsidizing system-wide averaging process was the cause of AT&T's high tariffs.

6.2.5.3 People and Politics Matter

Especially if one espouses Temin's view on the causes of divestiture, there are many "what ifs?" in this story -- revolving mostly around the actions of individuals. Had John deButts taken a more conciliatory strategy, had William McGowan not been as dogged, and had regulators like Bernard Strassburg and William Baxter not been "policy entrepreneurs," the anti-trust suit may never have been filed and/or may have never pushed AT&T to a point where it had little choice but to settle. While this lesson may not be directly applicable to the core of this thesis -- an examination of economic efficiency -- it is important to bear in mind that policy-making decisions are frequently made with more weight placed on politics than on technical analysis. In such a context, engineers should be cognizant of the perceived value of their conclusions and actively work to inform those who make the policy decisions from that standpoint. While such a process makes many an expert cringe, it is a fundamental part of democratic governance.

6.2.5.4 Understandability of a New System

In order for a competitive marketplace to exist, the participants in the market theoretically should have symmetric access to information. In a confusing environment, although information may be available, it is still "imperfect" in the economic sense if there are

[74] Temin, 1987, 20.
[75] Rennie, 1995.

differentials in the ability of people to use it in a meaningful manner. Many "ordinary" people are confused by the complexity of their choices in the deregulated telephone system and therefore do not make economically efficient choices. With electric power provision being even more complicated than telephone service, Navarro notes that "choosing from a menu of electricity services will be much more complex than, say, choosing a phone plan, and the evidence suggests that this is already too confusing."[76] Thus, a structure that presents customers with choices that are as straightforward as possible is desirable for efficiency reasons.

6.2.5.5 Impact on Technological Innovation

The divestiture has resulted in a in technological innovation paradox. On one hand, the divestiture clearly had a positive impact on the development specific technologies, such as fiber optic cable.[77] Fiber optic technology was aided by the divestiture because it happened to be a maturing technology at the time that two national networks were being built (and a third was being rebuilt to match them.) Had those networks already been in place with a more mature technology when the breakthroughs in fiber optics occurred, the MFJ's positive impact on technological improvement of the transmission network may have been much smaller. The divestiture also likely had positive impact on the rate of technology adoption of other specific technologies. Prior to 1984, AT&T focused on Plain Old Telephone Service (POTS) and the equipment it used was largely developed through its captive producer Western Electric. The divestiture opened up the equipment market to new producers and allowed for a divergence of demands -- from service customers;[78] to the new long distance companies, to the seven "Baby Bells" -- who could then seek altervatives to Western Electric equipment. These circumstances allowed for a blossoming of new firms.and a divergence of development focus that allowed for the creation of entirely new technologies.

On the other hand, the divestiture has slowly eroded one of the crown jewels of the American research establishment, Bell Labs. As Rosenberg recently noted, "the diminished role of Bell Labs as a national resource for basic research reflects an insufficient appreciation for the role played by such private-sector research as a determinant of long-run economic growth."[79] Therefore, if one examines total social welfare, it is hard to make a

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[76] Navarro, 1995, 409.
[77] Sirbu, 1991, 336.
[78] Until the late 1970s, the telephone company owned almost all of the telephones that customers used, and even in 1984, it still owned most of them. Services such as call waiting and equipment such as answering machines were rare if non-existent prior to 1984.
[79] Rosenberg, 1994, 229.

definitive determination of the impact of the divestiture on technological development. The trade-off of modest technological improvements in telephone technology, with the deleterious impact on the basic research base of the nation, is difficult to evaluate quantitatively.

It should be noted that there is a danger in relying too heavily on any one particular case to make general conclusions. Bell Labs was an extraordinary organization. The electric power industry does not have the tradition of successful, massive industry-sponsored research and development. Instead, electric utilities have tended to be the consumers of innovations as opposed to the developers of them.[80] Therefore, one would expect that deregulation would not have the deleterious impact on technological development that it had in the telephone industry. In fact, deregulation should have a neutral,[81] if not positive impact on technological innovation. This has already been seen, at least to some extent, in the rise of the independent power producers (IPPs). These new entrants have helped to spur on, and provided a market for, new generation technologies.

With these lessons from the telephone industry now in hand, let us next examine the experience in natural gas deregulation.

6.3 NATURAL GAS DEREGULATION

6.3.1 Similarities Between the Gas and Electric Power Industries

There are numerous similarities between the gas and electric power industry in their physical structure, history, and regulation. For example: the same federal regulatory body (the FERC) is responsible for both natural gas and electricity, a number of large utilities have both gas and electric divisions, and the technology of both industries is broken into three parts: production, transmission and distribution. Furthermore, just like the electric power industry, regulatory power is shared between the federal government and the states. In the case of natural gas, state commissions (often the same body that regulates electricity) have domain over the local distribution companies (LDCs).[82] Despite these obvious similarities, the most important one for the purpose of this thesis is that both industries

[80] Joskow and Schmalensee, 1983, 87.
[81] One could anticipate that the Electric Power Research Institute (EPRI), a research consortium of electric utilities that was started in 1973, will have similar problems to those of Bellcore, as its members have increasingly divergent interests, if not become direct competitors. EPRI has been responsible for some technological development in generation and transmission so there will be some negative impact to cancel out the anticipated positive impact.
[82] Boswell, 1992, 27.

have been undergoing a process of deregulation. Since the natural gas industry has been experiencing increased competition before the electric power industry, there are lessons that can be learned from the former to help the process of the latter. With that in mind, let us examine the experience of the gas industry.

6.3.2 <u>History of Gas Industry</u>[83]

6.3.2.1 Early History

Early in its history, the gas industry was cited as a classic natural monopoly by a host of economics theorists,[84] a fact which ultimately led to the establishment of gas distribution franchises and government regulation of them (at either the city or state level). Until technological advances in steel and welding allowed for the interstate transport of natural gas, the industry relied upon gas manufactured from coal. However, natural gas had a higher BTU content and was being discovered (and discarded) along with oil. Therefore, when technology made it possible, interstate natural gas pipelines were built, starting in the late 1910s. For more than a decade a regulatory gap existed, since only state regulation existed but the blossoming natural gas system spread across multiple states. Furthermore, the Supreme Court disallowed state regulatory action over interstate pipelines. The result was that, much like electric utilities, gas companies ran circles around state regulators until the depths of the Great Depression.

6.3.2.2 Regulation Comes to the Industry

The natural gas industry experienced its first taste of federal intervention in the mid-1930s, with the passage of the Public Utility Holding Companies Act of 1935 (PUHCA). This law was the first of twelve significant federal forays into the gas industry that would occur over the next six decades.[85] As with the electric power industry, PUHCA was applied to the gas industry to correct the abuses of the holding companies.[86] Between 1940 and 1954, the Securities and Exchange Commission broke up 158 gas utilities with an asset value of $874 million.[87] This largely destroyed the vertical and horizontal integration that had been prevalent in the industry before PUHCA.

In 1938, soon after the passage of PUHCA, the Natural Gas Act became law. The law was formulated because Congress concluded that:

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[83] The information contained in this section comes from narratives by Vietor, 1994; and Pierce, 1988.
[84] For a discussion of this, see: Pierce, 1988, 2-3.
[85] Vietor, 1994, 163.
[86] Vietor vividly describes a holding company as "a financial octopus that ignored regulators and preyed on consumers." Source: Vietor, 1994, 96.
[87] Ibid., 100.

> the business of transporting and selling natural gas for ultimate distribution to the public is affected with a public interest, and that Federal regulation in matters relating to the transportation of natural gas and the sale thereof in interstate and foreign commerce is necessary in the public interest.[88]

The Act required the Federal Power Commission (FPC) to establish "just and reasonable rates" in three areas: sales for resale in interstate commerce, transportation in interstate commerce, and facilities used for such sales and transportation.[89] The wording of the law was vague and, as a result, its interpretation by the FPC for the next 30 years would be a source of great contention. While the story is an interesting one, for the purpose of this thesis, we will skip many of the details.

6.3.2.2.1 Regulation of pipelines

After 1938 pipelines were regulated by the public utility model. Pipelines would buy gas from producers, transport it through their pipelines (over which they had control), and sell it to distribution companies. As a public utility, they were entitled to earn a fair return on their investment, based upon a commodity charge (for the volume transported) and a demand charge (to pay for the capital costs of capacity).

6.3.2.2.2 Regulation of producers

As a result of FPC and court decisions, by 1954 the rates of well-head gas were tightly regulated through the utility model. As time passed, this method was replaced by price ceiling regulation, which was intended to make the FPC's workload more reasonable. In the process of creating the price ceilings, the FPC realized that higher prices would stimulate more production (and discovery) of gas. Therefore, in order to avoid shortages while preventing gas companies from making windfall profits on previously operating facilities, the FPC started a two-tier price schedule, where a higher price would be allowed for new gas. Unfortunately, there were several fundamental problems with the production price regulation that had gradually developed. The first was that the price adjustment process was slow. Secondly, the price structure ignored the fact that gas is a depletable resource, and as such, it would become more valuable in the economic sense and more expensive to discover and produce with time. These flaws were not easily spotted during the 1950s and early 1960s, when the cost of gas was relatively steady and the commodity was in plentiful supply. As the 1960s wore on, though, the rising costs of exploration and the low economic incentives for such activity were causing a marked decrease in the drilling of new wells,[90] setting the stage for problems in the coming decade.

[88] PL75-556, 821.
[89] Pierce, 1988, 6.
[90] Vietor, 1994, 114.

6.3.3 Shortage in the 1970s

The slowly building problem that resulted from these inappropriate incentives, when combined with the extreme economic conditions of the 1970s, was a recipe for disaster. Although the FPC realized in the late 1960s that a problem was brewing, it was hampered in its attempts to solve it due to the slow process of bureaucracy and liberal intervention in the regulatory process and by the courts. Even as energy prices began to escalate rapidly, the slow pace of regulatory change meant lags of four years between price increases. The result was predictable: supply was curtailed. However, the curtailment was not evenly spread, because while interstate transactions were regulated and subject to price caps, intrastate transactions were beyond the purview of the FPC and thus followed the "market" price level. As the disparity between the market and regulated prices continued to widen, intrastate customers had access to plentiful (and expensive) supplies of gas, while the interstate customers, who were being "protected" by regulation, were facing massive shortages.[91] These shortages resulted in widespread school and plant closings as well as service cut-offs to residential users during the severe winter of 1976-77.[92]

In the mid-1970s the FPC speeded up its rate-making process by establishing national rates (as opposed to "area rates," which were implemented in the early 1960s), but it still could not adjust the price ceilings quickly enough and met with stiff resistance when doing so. While in hindsight, and in the minds of contemporary economists, the supply-demand-price problem was evident, many at the time did not understand it. In a comment that typifies the mentality of many intervenors during the era, Lee White, a former FPC chairman, stated, "we believe price to be one of the most regressive techniques for rations and allocation that there is."[93] While the intent of intervenors such as White was to protect consumers, they ignored the fact that the artificially low prices were costing the economy between $2.5 and $5.0 billion per year.[94] With economic losses and personal suffering (i.e. winter heating cut-offs) mounting, and a system that was unable to ameliorate the situation, the construction of a new framework was clearly needed.

[91] Sawhill, 1987,16.
[92] Quirk, 1991, 420.
[93] Cited in Vietor, 1994, 123.
[94] Pierce, 1988, 10.

6.3.4 NGPA: A Misguided Solution

6.3.4.1 The Bill and Its Formulation

The solution to this problem -- natural gas deregulation -- was one of the most contentious issues of President Carter's National Energy Policy. After much wrangling, Congress passed (as a sister bill of PURPA) the Natural Gas Policy Act of 1978 (NGPA).[95] At the Bill's signing, Senate Majority Leader Robert Byrd commented, "this [natural gas deregulation] has been the toughest of all the issues as far as I'm concerned that I have ever seen come before the Senate."[96] The Act was a "marvel of complexity" that had two principal features: (1) a separation between old and new gas (for the purposes mentioned previously) and (2) a partial unification of the interstate and intrastate markets.[97] To achieve these goals, the Act created eight separate gas classifications and carefully defined price ceilings and escalators for each. The Act permanently retained price ceilings on "old gas" (with adjustments) while it steadily raised the ceilings on "new gas" so that the 1985 ceiling price would be equivalent to 1985 oil prices, at which time the well-head price of new gas would be deregulated.[98] The law also defined pass-through requirements and rationing procedures, should the latter become necessary.[99] In analyzing NGPA and its process Quirk states, "the final bill ... was an incoherent, lowest-common-denominator solution that an exhausted Congress preferred to the alternative of failing to act."[100] With the legislation having been forged in such a manner, it should not come as a surprise that its impact was not what had been anticipated.

6.3.4.2 The Aftermath

6.3.4.2.1 Incorrect assumptions

Unfortunately, the NGPA caused more problems than it solved. In hindsight, President Carter's unprophetic words -- "[the Act] will end 30 years of debate over how natural gas should be regulated, how it should be priced"[101] -- appear ludicrous, even humorous, given the havoc and inefficiency that it wrought on the industry during the 1980s. The heart of the problem with the legislation was that it was based upon several assumptions that were incorrect. The errant assumptions were: there would be a permanent shortage of gas, demand would continue to rise, and energy prices would continue to rise.

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[95] For an interesting account of the political process, see: "Energy Bill: The End of an Odyssey," 647-663.
[96] Carter, 1978, 1983.
[97] Carpenter et al, 1987, 70.
[98] Although the President and Congress were given the authority to reinstate price ceilings at that time (and until 1987) should such action be warranted.
[99] PL95-621.
[100] Quirk, 1991, 422.
[101] Carter, 1979,

Why were these assumptions wrong? The first assumption, about the permanence of gas shortages, was incorrect because the artificially low gas prices of the 1970s had deterred both the production and discovery of gas to below the natural market clearing quantity (and price). Given the sub-market prices for gas, there was little incentive to find (and prove) reserves.

The second assumption, regarding the demand for gas, was incorrect for several reasons. For one, the shortages during the 1970s diminished consumer (and in particular, industrial) confidence in the gas supply, which led some to either change supplies outright, or at least make facilities able to run on multiple fuels. A second cause of lower demand was mandated by law, the Power Plant and Industrial Fuel Use Act (PIFUA), which placed outright bans on the use of gas for some uses - such as electric power generation. Thirdly, as gas prices rose while the prices for other energy sources declined, gas lost its competitive advantage. And finally, the energy crisis of the 1970s sparked interest in conservation. The result of these factors was predictable, gas demand did not rise at the expected rate, and in fact, gas deliveries fell by 14% between 1981 and 1983.[102]

The cause of incorrect assumption about energy prices is much more complicated. The price increases in the 1970s were driven by instability in the Middle East. Energy prices did rapidly escalate again soon after the passage of NGPA, as a result of the 1979 Iranian Revolution. When the political situation stabilized (or at least became relatively stable) and when the oil cartel (OPEC) lost its tight grip over its members, oil prices began a protracted decline. Between 1980 and 1982, the cost of a barrel of oil fell from $40 to $25.[103] However, the price of natural gas continued to escalate by law on its way to the 1985 target price. By 1985, the ceiling price of natural gas had risen 67% since 1981 while the price of oil had dropped by more than half in the same period.[104]

6.3.4.2.2 Minimum bills and take-or-pay

Compounding the impact of these incorrect assumptions was that period's standard practice of purchasing gas under 15 to 20 year contracts. Two typical features of these long-term contracts were minimum bills and take-or-pay provisions. The latter meant that a pipeline was obligated to pay for a fraction of the gas that it contracted for,[105] even if it did not

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[102] Carpenter *et al*, 1987, 12.
[103] Kalt and Schuller, 1987, 4.
[104] Pierce, 1987, 23.
[105] The average take requirement in the period 1979-1982 was 79%. Source: Vietor, 1994, 127.

"take"[106] (delivery of) it. A minimum bill was an analogous arrangement, where a distribution company would commit to purchasing (or at least paying for) a minimum amount of gas, regardless of whether or not is was actually sold or needed. These were the "insurance clauses" of long-term contract to prevent opportunistic behavior, but they also limited efficient behavior.[107]

In 1979 and the early 1980s, as natural gas prices rapidly rose, pipelines and distribution companies were eager to guarantee their capacity quickly, and as a result, producers could extract top dollar from each new contract. Since gas demand had always risen, these contracts assumed a continuing increase in demand. However, as has already been noted, the demand for gas not only stopped rising, it dropped significantly. Furthermore, instead of contracts that purchased gas at or below the market rate for energy (as had been historically true), these contracts locked in the LDCs and pipelines at prices which were quickly rising above the equivalent cost of alternatives, such as oil. Therefore, within several years, the pipelines and the LDCs found themselves with contracts that no longer made economic sense. Furthermore, the incentives to alleviate the consequences of these contracts were not efficient. In order to minimize losses, a pipeline that both a low-priced and a high-priced take-or-pay agreement would "take" the high cost gas, which then would be sold to its customers (the LDCs) at the high price, while "paying" for (but not taking delivery of) the lower cost gas. Likewise, minimum bills prevented prices from transmitting appropriate market signals to distributors and end-users. Consequently, LDCs and end-users did not switch from higher-priced contracts to the lowest-cost pipeline supplier.[108] In the early 1980s the situation had become very confusing: while demand was falling, prices were rising. Vietor comments on this situation,

> By 1983, as the pressures against rising end-user prices intensified and as the take-or-pay liabilities of pipelines mounted, criticism of the Natural Gas Policy Act was universal ... no one understood clearly whether it was regulation or deregulation that was causing gas prices to rise while demand fell. And not knowing the future, none of the participants realized that oil prices had just begun to fall. Since it was too early to assess the effects of the Natural Gas Policy Act, it was hard to see that industry structure and perverse contracts could not coexist with competitive gas supply markets and substitution by large users.[109]

Although confusion reigned, what was clear was that something needed to be done.

[106] Kalt and Schuller, 1987, 4.
[107] Kalt, 1987, 104.
[108] Vietor, 1994, 145.
[109] Ibid., 1994, 140.

6.3.5 The "Clean Up" of NGPA

6.3.5.1 Order 380

In order to alleviate the distortions that the NGPA had created, the Federal Energy Regulatory Commission (FERC) issued Order 380 in 1984. This Order invalidated the variable cost component of minimum bill provisions, citing them as anti-competitive.[110] This essentially freed the LDCs of their minimum bill obligations that in some cases were forcing them to purchase gas at a much higher price than could be obtained from another source.[111]

While the order was a start, it was not sufficient to "fix" the problems caused by the NGPA. In fact, it exacerbated them. Suddenly, the pipelines were facing asymmetric risks. Prior to Order 380, there was a symmetric risk since the pipeline could hold LDCs accountable for the gas they contracted for, just as the producers could hold the pipelines accountable through take-or-pay provisions. Now, the LDCs could escape their contractual agreements with the pipelines being stuck holding the bag.

6.3.5.2 Order 436

On 9 October 1985, FERC issued Order 436, which promoted (but did not mandate) the concept of pipelines as common carriers. The FERC issued this Order because it was confronted with a situation where: there was a generally competitive market in the commodity of natural gas and a highly integrated transportation network that was highly monopolistic in some markets but fairly competitive in others.[112] The FERC established six objectives to handle this situation:[113]

- to flow economic rents through to consumers as Congress originally intended;
- to give producers correct price signals;
- to give consumers correct price signals;
- to eliminate the pipelines' incentive to make imprudent purchasing decisions;
- to produce a "level playing field" between competing gas sellers, particularly between pipelines with access to large supplies of under priced gas and all other competitors; and
- to avoid the inequity of having new customers benefit from old gas rents.

These principles were embodied in the three major provisions of the Order:[114]

- Transportation: Pipelines would be given the option of providing nondiscriminatory transportation service. This allowed third parties to send gas along the pipeline on nondiscriminatory terms. This unbundled the pipelines'

[110] Pierce, 1987, 23.
[111] Vietor, 1994, 141.
[112] FERC, 1985, 42413.
[113] These are taken from the Notice of Proposed Rulemaking for Order 436, issued 30 May 1985; cited in: Williams, 1985, 30-34.
[114] FERC, 1985, 42409-42410.

transportation function from their sales functions. For those pipelines who chose not to avail themselves of this option, traditional sales and transportation options would remain available (and bundled) under the Commission's existing certificate authority (which meant that pipelines could not serve or charge selectively).[115]

- Take-or Pay: Those pipelines that did choose to offer nondiscriminatory transportation would receive favorable and expedited consideration in their attempts to ameliorate their take-or-pay liabilities. (Nothing was guaranteed, and a more comprehensive sheltering of pipelines was taken out of the original proposal.)
- Optional Expedited Certificates: Pipelines that agreed to offer nondiscriminatory transportation service would be given expedited certification of any competitive services that they might propose to undertake. (Provided that such services met requirements with regard to the prevention of cost-shifting.)

There was a fourth major provision of the proposed rule-making that was largely disposed of in the final Order. This would have created three blocks of pricing for gas, old gas (still subject to price regulation), new gas (prices set by market rates), and non gas-purchasing costs (which would be divided among the first two blocks.) Existing firm sales customers would have top priority for the cheapest (old) gas.[116] Prior to this, pricing had been done on a "rolled-in" basis where the price was determined by the weighted average cost of gas.[117] However, this provision was abandoned as a result of the contentious discussions that revolved around the proposed rule-making.[118]

A serious error in Order 436 was that it did not satisfactorily address the mounting "take-or-pay" burden faced by the pipelines. In fact, Order 436 worsened it. While the Order further relieved the purchase obligations of the pipelines' resale customers, it held the pipelines accountable for their upstream purchase requirements.[119] This resulted in pipelines incurring $6.1 billion of added exposure in 1986 alone.[120] By 1988, the return on equity of gas pipelines dipped to approximately 3%.[121] As the pipelines suffered, so too did the shift to a more competitive market. Since Order 436 required the "voluntary" action of pipelines in order to achieve its goals, pipelines had the ability to slow the emergence of a more competitive market by foot-dragging and lawsuits.

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115 Pierce, 1987, 25.
116 FERC, 1985, 42410.
117 Ibid., 42414.
118 This is described as the "Natural Gas Revolution of 1985." Source: Williams, 1985.
119 Santa, 1994.
120 Source: "Pipelines' Take or Pay Costs Continue to Mount."
121 Kolbe *et al*, 1993, 175.

6.3.5.3 Order 500

With staggering losses mounting in the bottleneck segment of the industry, further action was necessary. In 1987, relief (for the pipelines) came about as a result of the (judicial) ruling in the case of *Associated Gas v. FERC.* A federal court overturned Order 436 on the grounds that it did not adequately address the take-or-pay issue. The FERC's response was Order 500, which allowed for 100 percent recovery of take-or-pay commitments through a commodity-based rate.

6.3.5.4 The Rise of Competition

The ensuing years saw a continued rise in competition in the market. Between 1985 and 1988, the percentage of gas flowing through the pipelines on a carriage basis[122] jumped from approximately 10% to over 50%.[123] In early 1992, the Interstate Natural Gas Association of America (INGAA) issued a report that stated, "While the pipeline industry sees competition as a spur to efficiency and vigor, the industry is reeling from the burden of regulation that does not reward efficiency."[124] Such a finding is not surprising, given the function of regulation. As Vietor notes, "By its very design, economic regulation was meant to neutralize surplus earnings that might result from efficiency gains or marketing success. Thus, it conflicted squarely with the organization incentives needed for competitive effectiveness."[125] Thus, while many strides had been made in moving toward a competitive gas market, the continued market power of the pipelines[126] still stood in the way of true competition.

6.3.6 <u>Order 636: A New Era Begins</u>

6.3.6.1 The Order

On 8 April 1992, the FERC took definitive action by issuing Order 636.[127] The intent of the order was:

> to ensure that transportation service is equal in quality for all gas supplies, whether the customer purchases the gas from the pipeline or from another supplier. This should maximize the consumer benefits of the competitive

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[122] Carriage means transportation for another company. In electric power jargon, carriage is wheeling. The alternative to carriage was transportation on a sales basis. This was gas that pipeline companies would themselves sell to LDCs.

[123] Vietor, 1994, 152.

[124] Source: *Financial Health of the Pipeline Industry*, cited in "INGAA: Regulatory Uncertainty To Blame for Pipelines' Fiscal Woes."

[125] Vietor, 1995, 165.

[126] Van Sandt and Mespelli, 1995, 67.

[127] The final version, Order 636-B, was issued on 27 November 1992. It offered few substantive changes from the original order. Source: "FERC Approves 'Final' Version of Order 636."

> wellhead gas market by allowing buyers of natural gas to reach as many sellers as possible, thereby ensuring that the most efficient and beneficial transactions take place.[128]

The effect of this order was to change gas pipeline companies from full-service gas providers into common carriers. Included in Order 636 were the following provisions.[129]

- Interstate pipelines must provide transportation unbundled from their sale of gas;
- Customers must have unbundled access to storage services at storage facilities;
- Pipelines must sell gas on a basis similar to unregulated sellers;
- Pipelines must use a straight-fixed variable rate structure;[130]
- Pipelines must make all necessary information available to all potential market participants in a timely and equal manner through the use of an electronic bulletin board (EBB); and
- Pipelines will receive 100% of costs stranded by the Order.

The underlying result of the order is that the pipelines would have no advantage over any other market player in the gas merchant business.[131]

6.3.6.2 The Industry Since Order 636

In the three years since Order 636, the gas industry has rapidly emerged as an active commodity market. Sophisticated financial instruments have been developed in order to meet the new challenges posed by unbundling. Significant amounts of money have been invested in creating new facilities to handle the new marketplace.

One of the first challenges of implementing Order 636 was that of standardizing Electronic Bulletin Boards (EBBs). Given the state of technology at that time, the EBB mechanism was arguably the best for achieving the FERC's mandate of equal access to all information necessary for unbundled service for all potential traders.[132] However, if effective use of each EBB required detailed knowledge, unique to the specific EBB, there would still be information asymmetries. Creating a standard, though, was not a simple task. It was not until 24 March 1994 (Order 636 took effect on 1 November 1993)[133] that the industry came to agreement on a standard. Upon announcing it, the four natural gas trade groups said, in a joint statement,

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[128] FERC, 16 April 1992, 13267.
[129] These are summarized from: "Quotable," 10 April 1992 and Trabandt, 1993, 30; except where noted.
[130] In this rate scheme, all fixed pipeline costs are in the demand charges, which are paid regardless of how much capacity a customer actually uses. Source: "FERC Approves Final Gas Pipeline Rule," 1.
[131] Kolbe *et al*, 1993, 228.
[132] Parker, 1994, 31.
[133] Source: "New Competitive Era Dawning for U.S. Natural Gas Industry," 4.

> Electronic gas standards are key to increasing demand for natural gas because they make it easier to buy and sell, reduce costs associated with buying gas and planning for its movement and increase the speed and accuracy of the industry's business transactions.[134]

In the past two years, EBBs have not only served as sources of information (price discovery, market reporting, and operation), they have also become catalysts and places of consummation for new types of transactions.

In what may foreshadow the future of the electric power industry, during the past two years gas marketing centers have begun to emerge[135] and gas marketers have thrived in the new competitive environment.[136] Many of these centers have developed at physical hubs on the gas pipeline system.[137] Three key elements of an effective hub and center have been identified as: (1) use as a pricing and physical transfer point, (2) liquidity (there are a number of buyers and sellers) and (3) storage.[138] The last, which will be technically difficult to replicate in the electric power industry[139] has been the subject of significant investment interest in the natural gas industry.[140] Some predict that similar market centers will develop in the restructured electric power industry,[141] perhaps also at key physical interconnections on the grid. While future electric power market mechanisms are difficult to predict, the "electricity market" may very well resemble the thriving commodity market that has been developed in the gas industry.[142]

6.3.7 Lessons from the Gas Industry

Having discussed some of the highlights of the industry's history, let us now examine some of the efficiency lessons that can be learned from this case.

6.3.7.1 Equitable Handling of Transition Costs

The first lesson is that in the process of moving from one regulatory regime to another, there must be an equitable distribution of the transition costs. Coming to such a state in the gas industry was a long and painful process. To some extent, at least, the switch from a highly controlled utility industry to a blossoming commodity market was delayed for nearly

[134] Source: "Gas Industry, Eyeing Electric Power Mart, Moves to Make Buying, Selling Easier," 1.
[135] Source: "Gas Companies Plan Marketing Center."
[136] Source: "Natural-Gas Industry Expands into a Marketing Business."
[137] Although given the electronic nature of trades, they are both "real" and "virtual" centers.
[138] Vallen and Sharp, 1995, 27..
[139] Although storage might be possible to emulate through power swaps. Source: Vallen and Sharp, 1995, 34.
[140] For example, there were nearly 100 storage projects being planned at one point in mid-1994. Source: "What's In Store for Gas"
[141] Vallen and Sharp, 1995.
[142] Source: "Electricity Contracts Generate a Buzz Among Firms."

a decade due to the inequitable treatment of gas pipelines with respect to the take-or-pay contracts, which would be analogous to stranded investments in today's electric power industry. For example, Order 436, which resulted in a major change in the industry, was delayed due to court intervention and slow pipeline response as a result of the stranded cost issue. These delays protracted the highly-inefficient state that the industry was in during the 1980s. Had the court not stepped in when billions of dollars continued to be lost, the industry could have become crippled when pipelines, which are now viewed as common carriers, went bankrupt.

6.3.7.2 Regulation in a "Partially" Regulated Industry

A second lesson is that when an industry is partially regulated, i.e. some parts are regulated while others are not, there must be correspondence between market imperfections and those parts which are regulated. As Pierce notes, it was in the *transmission* (the gas pipelines) and distribution of natural gas where the market power[143] had existed. The production process, with many producers and low barriers to entry and exit, met the conditions of a competitive market. Yet, the federal government, which has domain over production and transmission, during the period 1938 to 1985 focused its efforts on utility regulation of the production segment of the industry. Furthermore, instead of treating pipelines as common carriers, the FPC (and later FERC) increased their market power by allowing them to be transportation *and* sales companies.[144] Thus, instead of alleviating market imperfections, the Natural Gas Act (and subsequent interpretations by the courts) caused great market distortions through its regulation of a competitive segment of the industry while shielding the pipeline industry. During the past decade, when the regulatory scheme has been "reconstituted"[145] to fit the economic and technical characteristics of the industry, the industry has become more efficient and is beginning to flourish as a commodity market.

6.3.7.3 Pricing Must Send Correct Signals

One of the clearest lessons of this story is that pricing really does impact the behavior of buyers and sellers, even in a regulated market. While this is an intuitive concept to economists, it is often forgotten in the heat of the policy-making process by people who

[143] With respect to pipelines, in some places this is merely significant market power, in regions of lower demand, it is natural monopoly power. Source: Pierce, 1988. In 1987, only 46% of markets in a study by DeVany and Walls were co-integrated. Thus, in 54% of the cases, the pipeline held a monopoly position. Source: DeVany and Walls, 1993.

[144] Pierce credits this to effective lobbying by the pipeline industry. Source: Pierce, 1988, 6.

[145] Reconstitutive law is the adoption of "new strategies for achieving national goals in lieu of the centralizing command and control techniques relied upon so heavily in recent decades." Source: Stewart, 1990, 352. For a more detailed description of the theory, Stewart suggests: Richard B. Stewart, "Reconstitutive Law," *Maryland Law Review* 86 (1986).

should know better. This case illustrates how prices affect both the quantity demanded and the quantity supplied -- during the 1970s when shortages occurred because of low prices, and in the 1980s, when surpluses occurred due to high prices.

One particular lesson here is that in regulatory environments where customers are given different degrees of protection, market distortions and inefficiencies can occur. In this case, interstate customers paid significantly lower rates than those in the gas-producing states, but they were also subjected to shortages during an especially cold winter. To conclude that special protections are never warranted would be an extreme interpretation of this case; however, before they are enacted, careful consideration should be given to the likely consequences, since those who are intended to be helped may be actually hurt in the process, and at a cost to social efficiency.

6.3.7.4 Robustness of Market Structure

The NGPA clearly demonstrated that market structures, especially when they are developed by legislative action (which is more difficult to amend than regulatory decisions), must be insensitive to assumptions about the conditions of supply, demand, and price. The Act had, as fundamental principles, predictions that turned out to be opposite of what occurred. When the market conditions changed, instead of being useful, the NGPA caused more problems than it solved. Rather than focusing on a particular situation, effective regulation offers incentives that encourage all parties to behave efficiently, no matter what the future holds.[146]

6.3.7.5 Marketplace Development

The final lesson (for the purposes of this thesis) from the gas industry case is that the marketplace must be allowed to develop in a non-prescripted, fair, and open manner. One of the surprises of the Order 436 experience was the rapid rise of gas marketers. Very few of these agents existed in the mid-1980s.[147] While in Order 436 the FERC did recognize the emerging importance of marketers in an industry where gas was becoming a "separate and distinct economic commodity,"[148] the speed at which firms from within and outside the industry entered the marketing business was not anticipated.

As the markets opened up, firms from within and outside of the industry arose to play a prominent position in the marketplace. With them came new financial tools which were

[146] O'Neill and Whitmore, 1995, 71.
[147] Legato, 1987, 220.
[148] FERC, 1985, 42412.

developed for the industry (often adapted from other commodity markets) for the trading of gas. The success of Order 636 has demonstrated that this happens most efficiently when information on pipeline capacity is available to all players and in a format that is readily usable by all. Prior to Order 636, when the information was not made available to all, the market was not efficient due to information advantages on the part of the pipeline companies. While this situation was a hold-over from the days of vertical integration where pipelines, as individual entities, could operate more efficiently with free intra-firm information flows. However, this situation represented was a local optimum point (for the pipelines) not a global one, and was a barrier to a more efficient overall market. Even when the pipelines were forced to make the information available to all in Order 636, there were still imperfections of information until the formats became standardized. Interestingly, the open information not only created a level playing field, but also prepared the ground for new forms of market transactions. EBBs have rapidly advanced from being mere providers of information to catalysts for market exchanges. Clearly, when allowed to do so, the opening of a market to competition that is freed from information asymmetries leads to the development of previously unimagined efficient structures. From this we can see that a goal of regulation should be to ensure that asymmetries of information and market power are eliminated, but at the same time, regulation should do so in a manner that allows for the creation of efficient new market structures.

6.4 SYNTHESIZED LESSONS FROM THE CHAPTER

Although they have been already stated on a case-by-case basis, let us now review and make more concise the applicable lessons from the telephone and natural gas industry cases. In doing so, we should recall that although there are many common characteristics of telephone; natural gas, and electric power systems, there are also important differences.[149] With this caveat in mind, let us reexamine the lessons and attempt to make them relevant for the electric transmission industry.

6.4.1 Market Structure Should be Robust to Changes

A lesson that was learned in both industries, but in different ways -- technology in telephone service and pricing in natural gas -- is that when a new market structure is formulated, it should be robust to a reasonable degree of change. At the same time, however, while some flexibility should exist, there is also a limit to the degree of robustness that is desirable. If a regulatory structure were to become so general that it no

[149] Pierce, 1988, 55.

longer was able to effectively handle the technical characteristics of an industry, then it too would lead to efficiency losses. Rosenberg offers a conceptual way out of this paradox,

> Policy should be constructed to ensure that the technological path *is as flexible as possible*, that resources are channeled toward those institutions which consistently provide large social benefits, and that viable economic opportunities are available to those who push out the technological frontier.[150] (emphasis original)

Thus, regulatory models should be dependent on a minimal number of fundamental assumptions about the technical structure of the industry while being able to adapt in the event that fundamental change does occur. Great care should be taken to ensure that these fundamental assumptions are built upon a reasonable long-term view rather than just a snap-shot, faddish view of the future.

6.4.2 Price Setting Matters

The process of establishing pricing mechanisms (whenever this is not done by the market) should be done based upon careful economic analysis. Regulatory price schemes should offer incentives that encourage all parties to behave efficiently, no matter what the future holds. Non-market price-setting can establish perverse incentives that can undermine social economic efficiency. This lesson is of particular importance to this thesis. As we saw previously, "there is no uniquely correct way to allocate fixed costs to units of production. There is also no uniquely correct way to allocate joint costs to disparate activities."[151] This economic principle is clearly relevant to transmission system pricing. In the AT&T case it was shown that "incorrect" pricing can lead to opportunities for companies to enter into a regulated situation as cream-skimmers that are not necessarily serving the best interests of overall system efficiency.

6.4.3 Available and Understandable Information

In order for a market to function efficiently, market participants must have equal access to a sufficient amount of understandable information. This allows for rational choices and prevents participants from having uneconomic, unfair advantages in the market. The need for understandable information is true on several levels - both with "average" customers who are currently confused with their telephone bills, and with sophisticated traders, who face information asymmetries when marketplace mechanisms are not standardized.

[150] Rosenberg, 1994, 228.
[151] Temin, 1994, 11.

6.4.4 Freedom For New Market Mechanisms

As both the telephone and natural gas cases make clear, the marketplace has changed markedly in the past decade, well beyond what could have been imagined at the time of divestiture and of the issuance of Order 436. Firms have found entrepreneurial ways to buy and sell natural gas and telephone calls that have increased the efficiency of the market. This being the case, highly structured market mechanisms that allow little leeway for development will likely impede long-term economic efficiency.

6.4.5 Equitable Sharing of Transition Costs

While this thesis argues that the long-term picture is important to bear in mind, and that the restructuring process should not be driven by transitional issues, that does not mean that transition issues are irrelevant. Even in the most revolutionary changes, such as the break-up of AT&T, the market develops in an evolutionary manner. If, in order to survive, firms must engage in behavior that is not optimal from the perspective of overall social efficiency (due to inequitable compensation for transition costs), both the short-term economic efficiency and the long-term direction of the industry are deleteriously impacted. This is especially true for the owners of bottleneck facilities, such as pipelines in natural gas and transmission lines in electric power. While some economists may assume, as an article of faith, that the market will move to its most efficient configuration over time, recent research on technology development shows that technological innovation is path-dependent.[152]

6.4.6 In Mixed Regimes Regulation Should Match Structure

In the two preceding cases there are segments of the integrated system that are technologically and economically ripe for competition and there are some that retain natural monopoly characteristics. In order to avoid distortions -- either from granting a regulated monopoly to a competitive function of the industry, or from making "competitive" a segment that is a natural monopoly -- it is important that regulatory structures properly match the characteristics of the segments of the industry. Yet, as was discussed in 6.4.1, these structures must be created with sufficient flexibility so that when technology changes, the structure can change with it.

6.4.7 People and Politics Matter

People and politics had an important impact on the efficiency and structure of the two industries. These factors have already been highlighted in the telephone story, but they

[152] For more on this topic, see: Section 9.5.1.

also played an important role in shaping the gas industry at three critical junctures. Despite the findings of the 1935 Federal Trade Commission reports, wellhead gas was regulated and pipelines were not treated as common carriers until 1985 due to successful lobbying by the former group. In the 1970s, as the gas shortages were breaking out and price ceilings appeared to provide part of the answer, the NGPA was formulated to let market forces play a greater role in matching supply with demand. As Kalt and Schuller note, "although this may appear to be an incontestably positive, if not innocuous, direction for natural gas policy to take, the NGPA was passed only after protracted and contentious congressional debate."[153] Later, in the 1980s, the resolution of the "take or pay" problem was delayed several years because LDCs and state commissions successfully eliminated from the final order the pipeline recovery mechanisms present in FERC's Notice of Proposed Rulemaking that preceded Order 436. From these examples it should be clear that market structures, and their efficiency, are not merely driven by technology or the "invisible hand." People and political situations do matter.

6.4.8 <u>What These Lessons Will be Used For</u>

These lessons will be used in order to develop criteria for long-term economic efficiency in electric power transmission. This criteria development will take place in Chapter 9, following the next two chapters, which also seek to bring concepts to the criteria development process. With that in mind, let us turn to an examination of some potential new transmission technologies.

[153] Kalt and Schuller, 1987, 1.

Chapter 7
Forthcoming Transmission Technologies

The permanent social welfare gains potentially available from a transition to a fully competitive electricity market dwarf even the highest estimates of the one-time, already sunk, costs of the transition.[1]

-- *Richard J. Pierce Jr.* (1994)

7.1 INTRODUCTION

Technological innovation has played an important role in the development of the electric power industry and is an important force in the industry restructuring that is currently underway.[2] Given the industry's history, the adoption of new technologies by IPPs (the industry's new entrants), and the experience of increased technological innovation in other deregulated industries, it is highly probable that technological innovation will continue. In fact, there are many electric power technologies currently being developed.[3] This chapter examines three transmission technologies that may have a significant impact on transmission systems in the future. We describe their basic technical functions and history of development, and we predict the economic and operational impact that they would have on transmission systems. One intent of the chapter is to demonstrate, using real technologies, how transmission systems *might* evolve over time so that allowances for efficiency-enhancing innovations can be considered in the development of deregulation proposals. This evaluation is done with the understanding that technological progress is difficult to predict. Consequently, it is imperative that deregulation proposals not be tailored to meet specific technologies -- be they the current ones or those under development. Rather, some degree of technological robustness should be built into new industry structures. A second intent of this chapter is to serve as an important background for the discussion of non-utility transmission systems.[4]

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[1]Pierce, 1994, 323.
[2]Source: "Holy Bypass! Technology is Destructive."
[3]Yeager, 1995.
[4]See Chapter 11.

7.2 POTENTIAL NEW TECHNOLOGIES

In this chapter we examine three transmission technologies, each with a different development lead time. The first, Flexible Alternating Current Transmission Systems (FACTS), are just starting to be used on the system. The second, superconductive transmission lines, will probably not be ready for commercial use for at least a decade. The development of the third technology, wireless transmission, is still in a nascent stage.

7.2.1 Near-Term Technological Advance: FACTS

FACTS are expected to be introduced into the industry on a large scale[5] within the next five years. FACTS are being "heralded as both the engineers' and accountants' salvation."[6] With such a billing, these technologies are undoubtedly worth a closer look.

7.2.2.1 The Basic Technologies

Rather than one technology, FACTS are actually a series of technologies,[7] all utilizing semiconductors. The basic building block of FACTS is the thyristor, a counterpart to the transistor that can control large power flows.[8] Its function is akin to the semiconductors that turn off and on (as the silicon goes from being an insulator to a conductor) on a micro scale in order to process the information that is being typed into this thesis. Instead of controlling milliamps; however, thyristors harness the same principle to regulate transmission line power flows. In keeping with semiconductor development in general, the thyristor is being improved at a rapid rate.[9]

FACTS allow utilities to increase or decrease power flows on specific lines, damp disturbances almost instantaneously, and increase the capacity of some lines.[10] These benefits come from the two fundamental advantages that FACTS have over traditional switching: they can redirect power in fractions of a cycle, compared to multiple seconds, if not minutes; and they do not wear out from use, whereas a

[5] Some FACTS devices have been used "experimentally" for several years already.
[6] Bickers, 1994, 95.
[7] Approximately a dozen are being developed. Source: Douglas, 1992, 5.
[8] Douglas, 1992, 9.
[9] Temple, 1995, 38. There are three generations of thyristors: silicon-controlled rectifiers (SCR), gate turn-off thyristors (GTO), and MOS-controlled thyristors (MCT). Source: Hingorani and Stahlkopf, 1993.
[10] Source: "Electric Utilities Are Looking for FACTS on Transmission."

traditional transformer is switched a maximum of a dozen times per day to prevent wear.[11]

The Electric Power Research Institute (EPRI) has supported research on these technologies for more than a decade[12] and the results of that effort are beginning to be witnessed in several successful demonstration projects. Thus far, about 5 FACTS devices have been developed, which include:

- Thyristor controlled series compensators (otherwise known as ASC), which allow for impedance modification;
- Static VAR compensators, which provide reactive power modulation;
- Thyristor-controlled phase angle regulators, which permit modulation of power phase angles;
- Gate turn off thyristors, which can keep voltages within acceptable limits and may also be used as "gates" that someday may allow for redundant electricity service on the distribution level;[13] and
- Unified Power Flow Controllers (UPFC),[14] which control power flow and provide voltage support.[15]

As many as a dozen FACTS devices may be in use within a decade.[16]

7.2.2.2 Projected Use of FACTS on the Transmission System

FACTS are expected to be added to both existing lines and new ones. They would replace devices such as electromechanical switches and static reactive power equipment. Due to their ability to stabilize the system rapidly, FACTS might also allow for a reduction in spinning reserves and reactive power support. In particular, FACTS would serve two useful purposes on the grid.

The first is that FACTS would allow for a more reliable, smoother power flow. High voltage FACTS "switches" can replace the electromagnetic switches that are currently used with generating equipment. Drawbacks of the old switches include the introduction of electromagnetic noise and instabilities into the system, and their slowness -- it takes several cycles to turn them on.[17] Because of faster switching times and clean (no noise) switches, FACTS are able to smoothen out power flow

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[11]Douglas, 1992, 6.

[12]Source: "Electric Utilities Are Looking for FACTS on Transmission."

[13]Hingorani and Stahlkopf, 1993, 84.

[14]The newest and most advanced types of FACTS devices -- which are scheduled to begin service by the end of 1996 in a demonstration project at American Electric Power's Inez substation. Source: "AEP Puts Transmission Technology into Practice.".

[15]Source: "AEP Puts Transmission Technology into Practice," 7.

[16]Douglas, 1992, 6.

[17]Hingorani and Stahlkopf, 1993, 78.

disturbances before sensitive equipment experiences them. Doing so with electromechanical devices is difficult, if not impossible. As the economy becomes increasingly dependent on electricity quality-sensitive semiconductor-based technologies, electricity reliability and stability become ever more important.[18] The transmission system could also become "self-healing," since thyristors can control impedance, voltage, current and phase angles in ways that cannot be regulated by mechanical switches.[19]

The second is that FACTS would allow for substantial increases, perhaps as much as 50% on some lines,[20] in the amount of power that transmission lines can carry because of their ability to "fix" otherwise potentially catastrophic instability problems. This would occur because FACTS would enable lines to operate at their thermal limits, rather than at lower limits that are often established to ensure transmission reliability in the event of unexpected occurrences. This capacity increase would be especially valuable in light of the changing nature of the grid. While the primary use of transmission systems was once to serve a utility's native load, they are increasingly becoming the primary thoroughfares for electric power sales. Today, almost 45% of all power consumed in the United States is sold through the wholesale market;[21] and with the move toward increased competition, the dependence on the transmission grid to facilitate electricity commerce will only increase. Thus, it will be necessary to increase the capacity of the transmission system, at least along some primary corridors. When compared with traditional network reinforcement (adding another conductor to a line or building an entirely new one) FACTS have several benefits:[22]

- Less environmental impact;
- Greater utilization of transmission lines and systems;
- Potentially relocatable; and
- Encouraging cost/benefit ratios.

For example, the first advanced services compensator (ASC) was installed on the Shiprock-Glen Falls transmission line in Arizona in 1992. Prior to the installation of the ASC bank, the line had been a bottleneck in the western power grid. The ASC

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[18] One estimate indicates that as much as 40% of all electricity is being processed by silicon. Source: Evans, 1994, 3.
[19] Ibid., 82.
[20] Ibid., 79.
[21] This number is calculated from data found in: Energy Information Administration, November 1995a, 59.
[22] Bickers, 1994, 95.

reduced the line's impedance by 72%, allowing the line to carry 33% power than it previously could.[23] The estimated pay-back period for this project is 4 years.[24]

7.2.2 Medium-Term Technological Advance: Superconductive Transmission Lines

Superconductive transmission lines are probably the best-known of the three transmission technologies we examine. During the late-1980s, superconductivity was a "hot" research area -- both figuratively and literally. This interest was spurred by the 1986 discovery of "high temperature" [57K(-406°F)] superconductors by two researchers at IBM Zurich. What ensued quickly captured the public's imagination. At the time, predictions were made of the imminent use of superconductors for a variety of purposes. The scene was described as follows:

> While thousands of scientists all over the world are competing on the possibilities to beat the latest temperature records, the man in the street is fed by the mass media with levitation trains, no loss energy conversion, no loss transmission systems and many other things that stimulate one's imagination.[25]

Since then, interest in the field has cooled, although progress is still slowly being made.

7.2.1.1 The Basic Technologies

In 1911, Dutch physicist Heike Kamerlingh Onnes discovered superconductors[26] -- materials with special physical properties that until recently have remained largely in the realm of esoteric physics. Their most important property is their ability to conduct electricity. When superconductors are at a temperature above their "critical temperature," they do not conduct any meaningful amount of electricity. However, when cooled below their critical temperature, they conduct electricity with no resistance.[27]

When he discovered superconductivity, Onnes was cooling Mercury to a temperature of 4K. For many years, pure metals and alloys were the primary superconductors. These materials made practical applications difficult, as their critical temperatures are approximately 20K.[28] In the 1960s, scientists discovered that intermetallic, ceramic compounds such as NbTi are also superconductors. Major

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[23]Pereira *et al*, 35.
[24]Ibid., 37.
[25]Bergsjo and Gertmar, 1989, 389.
[26]Chu, 1995, 162.
[27]Wiegner, 1995, 26.
[28]Chu, 1995, 162.

breakthroughs occurred in 1986 and 1987, when the warmest known superconductors went from having critical temperatures of 23K to 35K, then to 93K and finally to over 100K. The late 1980s was a period marked by a frenzy of scientific activity that has since slowed, but nevertheless continues. Today, the warmest superconductors have critical temperatures of 164K, and the critical temperature is gradually moving higher.[29]

Applications of these new materials are also being developed, although not without difficulty. One of the challenges of using today's superconductors is that they are ceramics rather than metals. Ceramic wires, for instance, are much more brittle than the traditional conduits.[30] Another difficulty is that superconductors must be kept so cold. Maintaining an environment of 150K is an expensive proposition (although it is much easier and less expensive than at 23K).[31] Before superconductors can be widely used in commercial applications, it will be necessary to increase their critical temperatures and to find ways of making them physically stronger. Advances in the latter area are now being made, and it is now possible to produce kilometer-long wires.[32]

Another problem which has already been greatly mitigated is the tendency for superconductors to lose their properties in the presence of strong electric and/or magnetic fields. In mid-1995 the record for current capacity was set by a team of researchers at the Los Alamos National Lab when a current density of 1 million amperes per square centimeter was passed through a yttrium-barium-cooper oxide wire (which loses its resistance to electricity at -292° F).[33] In contrast, a copper wire carries less than 800 A/cm^2.

7.2.1.2 Projected Uses of Superconductors on the Transmission System

Given their special properties, superconductors appear in principle to be perfectly suited materials for electric transmission line conductors. Various research programs have studied the feasibility of superconductive transmission lines since the 1960s. In 1986, a transmission system built at Brookhaven National Lab demonstrated that superconductive lines are technically possible to build and

[29]Chu, 1995, 165.
[30]Source: "Taped."
[31]Chu, 1995, 163; Wiegner, 1995, 28.
[32]Chu, 1995, 164.
[33]Source: "New Record Set for Superconducting Wire."

successfully operate on a small scale.[34] That is not to say, however, that these technologies were then (or are now) ready for commercial use.[35]

If the critical temperatures of superconductive transmission line conductors are sub-zero, their use would change the complexion of transmission systems. Instead of the dominating overhead towers and wires, new transmission lines would be built in cold, underground trenches. The potential benefits of superconductive transmission lines (compared to traditional conductors) include:[36]

- Resistance loss-free transmission;
- More compact space requirements;[37]
- Ability to operate at lower voltage;
- Less environmental impact; and
- Ability to send power over much longer distances.

One implication of the last point is that superconductive transmission lines could potentially transport power across the country, which would then create a truly national power system. At least one author has even suggested that a large number of natural gas generating stations could be built in Alaska, where gas is plentiful, with superconductors transporting the power to California[38] (and the rest of the Lower 48). An extension of this prediction is that superconductors could lead to an all-electric economy.[39] An even more far-reaching scenario is that all of the world's electric power needs could be fulfilled by building huge photovoltaic power solar cells in the middle of deserts and connecting these complexes to the grid through superconductive transmission lines.[40] These predictions do not take into account important factors, however. Resistive losses only dissipate 3%-6% of the power sent over a transmission line, so from a technical standpoint, superconductive lines would not lead to revolutionary decreases in losses.[41] Superconductive lines would also not solve reactive power problems, which in some cases can cause losses an order of magnitude higher than resistive losses.[42]

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[34]Forsyth and Thomas, 1986.

[35]This is especially true because it was just about the time that the testing was completed that the aforementioned revolution occurred in the superconducting world.

[36]Hosny and Dodds, 1993, 170-171; and the author.

[37]Due to their higher current/cross sectional area ratio.

[38]Greenberger, 1991, 38.

[39]Ibid.

[40]Johnson, 1993, 2.

[41]Furthermore, "if superconductive lines are built with non-room temperature superconductors, substantial "cooling" costs would be incurred." Source: U.S. Congress, Office of Technology Assessment, 1989, 121. On the other hand, 3%-6% of a $200 billion per year industry is a substantial amount of money.

[42]Ilic´, 18 September 1995.

In summary, superconductive transmission lines would allow for power flows over longer distances than at present, perhaps even allowing the creation of a national or international grid; but their resistance-free characteristics are not the panacea that some believe them to be.

It should be noted that wires are not the only area of superconductor development relevant to transmission systems. There is already a commercially viable electric storage product and several more are on the way.[43] More recent technological developments have come with respect to superconducting current limiters and converters.[44] These other uses may become even more significant than the adoption of superconductive transmission lines in their impact on the transmission system. A fundamental property of electric power systems, which differentiates them from almost any other, is the necessity to instantaneously balance load and generation without storage. Profound implications would result from the development of economical, large scale superconductive storage.

7.2.3 Long-Term Technological Advance: Wireless Power Transmission

The most long-term development in this evaluation is wireless power transmission (WPT), which would probably not be used on the system for at least 15 years.[45]

7.2.3.1 The Basic Technologies

Since the mid-1960s researchers have been exploring the possibility of WPT -- i.e., transmitting power from one point to another without the use of a conductor.[46] Several research routes for WPT have been explored.

The first employs microwave and millimeter-wave technologies. When this type of technology is used, electric power is converted to microwave radiation by a magnetron -- the primary device in a microwave oven.[47] The microwave radiation is then transmitted by an "antenna" -- typically a set of parabolic dishes. It is then received by a "rectenna," whose conversion efficiencies are in the range of 70% to 80%. Systems employing this technology have already been developed.

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[43]Source: "Using Superconductivity in Electric Power Systems."
[44]Source: "Gains Seen in Superconducting Current Limiter and Converter."
[45]Yeager, 1995; Johnson, 1993.
[46]Schupp and Brown, 1992.
[47]Although slightly altered. The conversion efficiency on these devices currently run at about 70%. Source: Schupp and Brown, 1992, 2.273.

Other researchers have been employing laser-photovoltaic systems. In these experiments, a laser emits a beam of energy which is received by a photovoltaic semiconductor. Three types of semiconductors are being used as receivers, the most advanced of which are GaAs-based[48] photovoltaics. The energy conversion efficiency of GaAs photovoltaics is upwards of 52%,[49] with a theoretical limit of approximately 70% under certain conditions.[50] The power received by the photovoltaic devices in these experiments is on the order of 100 mW/cm^2. Silicon-based photovoltaics are also being studied, although their energy conversion efficiency of 46% to 50%[51] is lower than for GaAs. The power of the light being transmitted in the most advanced research is on the order of 52 mW/cm^2.[52] The third type of photovoltaics being studied are InP (Indium Phosphide) cells. The chief advantage of these materials is that they offer better radiation protection than the other two types.[53] The highest measured efficiency for InP cells is upwards of 44%, with predictions of 50% in the near future.[54] This research is being done using powers on the order of 500 mW/cm^2.[55]

There are two general types of efficiency loss in photovoltaics, electrical and optical; both of which result from the crystal structures of photovoltaics.[56] Up to 95% of a light beam is reflected at the base of a photovoltaic,[57] which makes the ability to capture this reflection a critical engineering challenge in improving the efficiency of photovoltaics.

The advantage of laser technologies (over microwave ones) is their ability to transmit power over long distances. At the same time, though, they are more subject to atmospheric disturbances and are an earlier stage of development than the microwave technologies. At this point in time, laser-photovoltaic systems are only

[48]Landry *et al*, 1989; and Olsen *et al*, 1991.
[49]Olsen *et al*, 1991, 419.
[50]Ibid.
[51]Jain, 1993; and Zhao *et al*, 1995.
[52]Zhao *et al*, 1995, 3636.
[53]Radiation protection capability would be significant for space-based applications. Source: Jain, 1993, 1893.
[54]Jain, 1993, 1893.
[55]Ibid.
[56]Johnson, 1993, 2.
[57]Green *et al*, 1992, 317.

operable on a laboratory scale while microwave technologies have advanced to the stage of powering experimental aircraft. [58]

While substantial advances in these technologies have been made over the past three decades, much work must still be done before it is feasible to use WPT technologies in electric power systems.

7.2.3.2 Projected Use of WPT on the Transmission System

The two most likely applications of WPT in electric power systems would be earth-to-earth and space-to-terrestrial transmission.

In earth-to-earth systems, power would be generated at a typical generating station, transmitted conventionally to the laser or microwave radiation source, transmitted through the air, received, and either placed on another transmission system or used at the site of the receiver. Presumably, a power wave would be bounced off a satellite or some similar object as it is transmitted through the air.

In contrast, the space-terrestrial system would begin with in-space generation of power[59] -- probably on a photovoltaic device that is either in orbit or on the moon. Once generated, the power would be beamed to earth, either to its consumption point or to a conventional transmission system.

7.3 CRITERIA FOR EVALUATING THE IMPACT OF NEW TECHNOLOGY

In order for these technologies to be adopted on transmission systems, they will need to display beneficial characteristics or relieve constraints: be they technical, political or economic. Therefore, let us establish criteria for identifying potential benefits in each of these realms (realizing that there might be overlap).

7.3.1 Technical Benefits

- Would the new technologies increase the capacity of current transmission systems?
- Would the new technologies change the fundamental character of the transmission system?
- Would the new technologies reduce line losses, and if so, by how much?

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[58] In one trial, a plane was able to stay aloft at a height of 150 meters for upwards of 20 minutes. Source: Schupp and Brown, 1992, 2.272.

[59] Johnson, 1993; Schupp and Brown, 1992.

7.3.2 Economic Benefits

- Would the new technologies reduce the fixed cost of transmission?
- Would the new technologies reduce the marginal cost of transmission? By how much?

7.3.3 Political Benefits

- Would the new technologies alleviate political concerns with current transmission systems?

With these criteria in hand, let us examine how these technologies might change electric power systems.

7.4 EVALUATION OF POTENTIAL TECHNOLOGIES ON ELECTRIC POWER SYSTEMS

7.4.1 FACTS

7.4.1.1 Would FACTS increase the capacity of current transmission systems?

One of the largest benefits of FACTS is that they are anticipated to be capable of vastly expanding the carrying capacity of today's transmission lines. As has already been noted, these technologies offer increased power transport over the same conductors of up to 50%. There are several implications of this. The first is that FACTS would increase the amount of power that can be wheeled. Thus, they would help to promote competitive generation markets. Secondly, they would delay, if not eliminate, the need to build additional transmission capacity. As a result, their impact with regard to competition in transmission would be opposite of that in generation. By increasing the capacity of the current system, FACTS technology would reduce the necessity of building new lines, and therefore the number of potential opportunities for non-utilities to build those lines. This would also mean that the most efficient grid configuration would contain fewer lines, which would increase transmission ownership concentration and heighten transmission's natural monopoly characteristics.

7.4.1.2 Would FACTS change the fundamental character of the transmission system?

In general, FACTS would create significant improvements in the traditional functioning of transmission systems. In particular, they should allow existing systems to carry more power and to do so more reliably.

While the applications of FACTS would be evolutionary in nature, they possess one quality that at some point in time could change the nature of transmission systems. Because of their quick on-off times, FACTS could be the first "electric valves" placed on the system.

While FACTS would have the capability of gating power flows, it is unknown whether it would be used; and if it were, whether it would fundamentally change the character of transmission systems. Although individual transmission owners could use the "valves" to control access to their lines, such actions would have negative consequences on overall system efficiency, such as preventing power from flowing along the most technically efficient path. Furthermore, in an era when open access to transmission systems is viewed by regulators as being crucial to the success of a competitive industry, gating power flows would likely be politically intolerable in the context of the current system.

7.4.1.3 Would FACTS reduce line losses, and if so, by how much?

FACTS would significantly reduce reactive power-caused line losses. Furthermore, FACTS devices, themselves, could significantly reduce line losses, since they consume 1/10 to 1/20 the amount of power consumed by some of the devices they would replace.[60]

7.4.1.4 Would FACTS reduce the fixed cost of transmission?

In most cases, FACTS would increase transmission fixed costs in the short-run, but would reduce them in the long-run. This paradox exists because FACTS would reduce the marginal losses of the system, but would not reduce fixed costs in the short term. At the same time, these devices are fixed cost investments. The result is an overall increase in short-term fixed costs. However, with time the amount of power flowing over a transmission line increases -- eventually to the point of needing a new line. When FACTS reduce line losses by an amount that postpones or eliminates the need to construct an additional transmission line, there are significant fixed cost savings. It is estimated that for every 10% increase in cumulative line loading, FACTS could save the industry $6 billion in avoided construction costs.[61]

7.4.1.5 Would FACTS reduce the marginal cost of transmission? By how much?

FACTS reduce the marginal cost of transmission significantly. The payback period for some devices can be as short as 4 months.[62]

7.4.1.6 Would FACTS alleviate political concerns with the present transmission grid?

FACTS help to alleviate political problems of transmission systems by allowing heightened use of existing facilities, thereby reducing the number of new lines that must be built and the numerous political problems that accompany transmission line construction.

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[60]Hingorani and Stahlkopf, 1993, 85.
[61]Douglas, 1992, 6.
[62]Ibid., 8.

7.4.1.7 Summary

FACTS offer the potential for more technically efficient and reliable use of the transmission grid while lowering the marginal costs of transmission. In the process, they would reduce the need for the construction of new transmission capacity. In addition, FACTS hold the potential to change transmission system operation by gating transmission lines -- a capability that would be important, if not necessary, in creating non-utility transmission systems.

7.4.2 Superconductive Transmission Lines

7.4.2.1 Would superconducting technologies increase the capacity of current transmission systems?

Presumably, superconductive transmission lines would replace segments of the existing system. The magnitude of power that they would be able to carry would depend upon the stage of their technological development when introduced for commercial use. Because advanced superconductors are capable of carrying much larger amounts of current than metal wires in the laboratory, eventually superconductive lines should increase the capacity of the system, and consequently, the natural monopoly characteristics of transmission lines. However, the first commercial superconductive lines may not be capable of doing this.

7.4.2.2 Would superconducting technologies change the fundamental character of the transmission system?

One way that superconductors could fundamentally change transmission systems is that they *might* eventually allow for the creation of a national, if not international power grid which could be operated by one or a handful of control areas. The Alaska generating scenario is an example of the potential benefits of reducing transmission distance constraints. The continued existence of heterogeneous regional electricity price levels across the country would also serve as an incentive for a national power grid to develop. If industry restructuring would lead to more homogeneous prices without the aid of superconductors, however, this potential benefit of a national grid would be diminished. Price homogeneity need not kill the benefits of a national grid, since a national grid would allow for the futuristic scenarios mentioned above and could have other benefits as well.[63]

It should be noted that merely removing resistive losses would not reduce all of the significant constraints that exist on transmission systems. Superconductors would not

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[63]See Section 7.4.2.5.

solve problems such as reactive power and system instability. In fact, these become more complicated in larger systems.

Much more significant is the probable impact that the use of superconductors would have on transmission systems as electric storage devices. The current electric power industry structure is built upon the premise that electricity cannot be stored, which, combined with the need to instantaneously balance electric demand and supply, necessitates the provision of spinning reserves, automatic generation controllers, etc. It also means that all the electricity needed during peak periods must be produced during the peak period. As a result, expensive generators run during peak demand times, while less expensive ones sit idle during demand troughs. Furthermore, the market must perfectly clear at every given instant, a constraint that will become increasingly important as a true power market develops. These technological limitations make for tighter constraints on the electric power market than exist in most (if not all) other competitive industries.

It is difficult to imagine all of the potential consequences that would result from an undercutting of the fundamental assumption that electricity cannot be stored. Some likely ones include:[64]

- Reduction (if not elimination) of spinning reserves, and
- "Leveling" of generation quantities, resulting in a reduction in the number of generators.

Superconductive storage devices would take on the current roles of:[65]

- Load following;
- Spinning reserves;
- Transient stabilization; and
- Synchronous resonance damping.

While it is difficult to predict all of the reverberations that would result from the elimination of the no-storage assumption, it should be clear from the above lists that profound changes in the electric power industry would occur.

7.4.2.3 Would superconducting technologies reduce line losses, and if so, by how much?

One of the clear advantages of superconductive transmission lines is that they would eliminate resistive line losses, although they would not eliminate reactive power losses.

[64] This list is partially based on Bergsjo and Gertmar, 1989, 404; and Hosny and Dodds, 1993, 170; and partially on the insights of the author.
[65] Ibid.

7.4.2.4 Would superconducting technologies reduce the fixed cost of transmission?

Because of potential changes in technology, it is difficult to predict exactly how much superconductive transmission lines would cost to build; however, at least one estimate has been made. A 1987 study by the Department of Energy and Philadelphia Electric made three important conclusions about the future of superconductive transmission lines:[66]

- The cost of construction of such lines ranges from 1.5 to 1.9 times that of constructing a traditional overhead line;
- Superconductive lines are economically attractive alternatives to traditional underground lines for large capacity purposes only, with a minimum of 5000 MW; and
- Widespread use of superconductive lines for the distribution system would only be feasible with room temperature superconductors.

7.4.2.5 Would superconducting technologies reduce the marginal cost of transmission? By how much?

By eliminating resistive line losses, superconductive transmission lines would reduce the marginal cost of transmission quite significantly, since 3-5% of power placed on the grid is dissipated by line losses. While this may not be a revolutionary technical change, 3-5% of a $200 billion dollar industry does represent substantial savings -- $6 to $10 billion per year. Furthermore, if superconductive transmission lines would lead to the creation of a national grid, there generation reserve margin -- both installed and spinning -- could be reduced, which would further reduce the marginal cost of power. Superconductors, in the form of storage devices, would further reduce or even eliminate reserve margin capacities. On the other hand, if non-room temperature superconductors are used, significant marginal cooling costs would be incurred.

7.4.2.6 Would superconducting technologies alleviate political concerns with the present transmission grid?

Superconductive lines could reduce the public's concerns with transmission line siting, thus eliminating a key barrier to developing and expanding the grid.[67] Public concerns could be reduced because the superconductive lines would likely be built underground, which would allow lines to be built in locations otherwise not otherwise be possible, due to aesthetic or right-of-way difficulties.[68] However, superconductive lines would represent an entirely new technology. Public acceptance of new technologies often is not as high as might be expected.[69] This is because the public's acceptance of a new technology can often have more to do with the context into which it is introduced than its specific technical

[66]Bergsjo and Gertmar, 400.
[67]Rogers, 1994, 8.
[68]Forsyth and Thomas, 1986, 612.
[69]Postrel, 1995.

characteristics. As a result, superconductive lines could face unforseeable public acceptance problems.

7.4.2.7 Summary

Superconductive transmission lines would eliminate resistive transmission losses, a development that could save billions of dollars annually. Their benefit is less than might be anticipated because these lines might still require costly cooling, would likely be more expensive to build, and would not eliminate other significant constraints on the grid, such as reactive power. Two other potential benefits of superconductive lines are that they could create larger "tight pools," e.g. the creation of a single national or handful of super-regional control areas might become possible; and they may also reduce transmission line siting problems. Of even greater significance, however, would be the development of large-scale, economical superconductive storage. Such a development would hold the potential for profound changes in the functioning of electric power systems.

7.4.3 Wireless Power Transmission

Several factors make it difficult to predict the impact that wireless transmission technologies would have on electric power systems. The first is the sheer duration of the time lag between now and when the technologies would be adopted. It is difficult to predict with any degree of certainty what the system would look like when the technologies are adopted. Secondly, it is difficult to predict how even the present system would adjust to the technologies. As a result, the evaluation of WPT technologies is more speculative than for FACTS or superconductors. While the details of the impact of WPT technologies may not be clear, it should become clear that WPT technologies hold the potential to revolutionize the industry.

7.4.3.1 Will wireless transmission technologies increase the capacity of current transmission systems?

It is difficult to predict what impact WPT would have on the capacity of transmission systems, since they are still so far from use. It is reasonable to assume that the first WPT systems would not be able to handle as much capacity as today's high voltage lines, if for no other reason because today's photovoltaic receptors "burn up" under relatively low power flows. Whether that is a fundamental characteristic of the technology, or a characteristic of its relatively young development, is a question that can only be answered with time.

7.4.3.2 Will wireless transmission technologies change the fundamental character of the transmission system?

The impact of WPT technologies on the fundamental character of transmission systems depends upon how they are used. Two scenarios for WPT use can be proposed.[70]

7.4.3.2.1 Scenario 1: replacement of wires

Wireless technologies could be used as "replacements" for current transmission lines, but aside from eliminating the lines themselves, electric power systems would remain the same -- the grid would remain interconnected and customers would be serviced by distribution companies. In this scenario, electric power could easily and flexibly be sent to many locations by the simple redirection of a laser beam, rather than through a multi-billion dollar series of transmission lines that must be built to all of the places where power is needed. If one invokes the economic theory of "contestable markets,[71] this scenario has implications for the ability to deregulate the transmission segment of the industry. In terms of contestable market theory, the sunk costs of immobile transmission lines are the largest barrier to a "perfectly contestable" transmission market.

7.4.3.2.1 Scenario 2: increased flexibility and less centralization

The second scenario is that WPT technologies would allow for greater flexibility in system operation. Currently, transmission system nodes (where power is put on or taken off the system) are intimately interconnected and the system is constrained by the physical connections of transmission lines. Wireless technologies would change the nature of the system by eliminating some of the physical interconnections that exist. In the process, a less intimate relationship would develop, as system components would not be physically prevented from leaving the "system." What implications would this have?

While it is difficult to predict exactly how a "transmission system" would operate using wireless technologies, one could imagine that the central system control function could be bypassed, at least in some cases through direct, physical bilateral wireless transmission transactions.[72] This would allow customers the opportunity to bypass the costs of spinning reserves, etc. inherent in being connected to the grid.[73] By making it possible to

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[70]As will be more elaborated in Section 7.5, it is likely that at first, Scenario 1 is most likely. However, with time, Scenario 1 may evolve into Scenario 2.

[71]For background on this theory, see: Bailey and Baumol, 1984.

[72]As opposed to bilateral contracts in the current grid, where the electrons are co-mingled.

[73]The ability of WPT technologies to quickly "reconnect" to the grid would have an impact on power quality, and thus, the willingness of a customer to opt for such an arrangement. If technologies would allow for almost immediate reconnection, there would be great incentives for bypass. However, even if

bypass the system operator, wireless technologies would then remove the core natural monopoly characteristic of the transmission system -- at least for those who choose to bypass it.[74]

Wireless power transmission technologies could also reduce the centralized nature of system operation by reducing geographic constraints for the provision of back-up power. Similar to the superconductor case, reductions could be made in reserve margins since power could conceivably be received from anywhere in the country with the change of a laser beam. Furthermore, when an individual user or producer finds itself with excess (insufficient) power at a particular moment, it might be able to sell (buy) the power on its own through a "direct" wireless transmission, rather than rely on the power balancing functions of the system operator. While the details are sketchy, this scenario suggests that the impact of WPT technologies could have a similar impact on electric power systems as telecommunication satellites had on the long-distance telephone industry in the late 1970s and wireless telephones are having on local telephone service today.

7.4.3.3 Will wireless transmission technologies reduce line losses, and if so, by how much?

Wireless "line losses," caused by photovoltaic energy conversion inefficiencies, would be significantly higher than losses in current transmission systems. Although technological improvements would help, wireless technologies have are some theoretical limits.[75] While it is difficult to predict the state of the technology if or when it is introduced, wireless transmission technologies will probably not be used on a large scale[76] until "line losses" are significantly reduced.

7.4.3.4 Will wireless transmission technologies reduce the fixed cost of transmission?

In addition to WTP's technological limitations is a problem of high fixed costs. At this juncture, photovoltaics are rather expensive, and would likely make WPT uneconomical, at least for large scale transmission.[77] There may be some low-density niche areas where WPT would be more economical than traditional transmission technologies, however.

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power quality were to be impacted substantially, customers who do not place a high value on power quality would still find system bypass to be attractive.

[74]It should be noted that such a possibility already exists in the form of on-site generation.

[75]Estimates of the theoretical limits for energy conversion efficiency using today's basic technologies range from the mid-50s% to 70%. Sources: Olsen *et al*, 1989; Zhao *et al*, 1995; and Green *et al*, 1992.

[76]One could envision niche uses for the technology, such as supplying remote areas where the marginal long run cost of constructing transmission lines would exceed the summation of the short-run marginal costs that result from the wireless "line losses."

[77]Johnson, 1993, 10.

7.4.3.5 Will wireless transmission technologies reduce the marginal cost of transmission? By how much?

If the analysis regarding "line losses" is correct, then the marginal cost of WPT would be much higher than that of traditional technologies.

7.4.3.6 Will wireless transmission technologies alleviate political concerns with the present transmission grid?

Wireless power transmission would cause current siting problems to vanish into thin air, literally. However, as is often the case, WPT would create a whole new set of issues: Would the public feel comfortable with having laser beams of power going though the sky? What is the chance that an errant laser beam would annihilate a person on the ground? What impact would such technology have on air transport? Would the Defense Department attempt to place restrictions on this technology? What would the health effects be of having high-energy microwaves being sent through space? Would any company risk the potential legal liability of WPT? As time goes on, some of these potential concerns may go away, while others may serve as real impediments to continued development of WPT technology.

7.4.3.7 Summary

Wireless power transmission technologies hold the potential for revolutionary changes in the transmission grid by reducing the importance of centralized system operation, and diminishing, if not eliminating, the natural monopoly characteristics of transmission. However, until "line losses" (photovoltaic energy conversion inefficiencies) are alleviated, WPT would likely be used only in niche situations. At first, they are also expected to carry less power than traditional transmission technologies.

7.4.4 Technologies in Combination

7.4.4.1 Dynamics of Technological Change

Until now, our examination has focused on the potential impact of these technologies if they were introduced individually on the current grid. This, however, is not an appropriate assumption to make -- except perhaps for FACTS, which are starting to be used now -- since these technologies would not be introduced into a static situation. For example, WPT and superconductors would be introduced on transmission systems that already have FACTS and possibly other significant new technologies.

7.4.4.2 FACTS and Superconductors

When we examine the problem from the dynamic perspective, some of our conclusions may change significantly. For example, we find that the introduction of FACTS and superconductive lines, on their own, would tend to increase the economies of scale of transmission. But now, let us examine what happens when they are used together. We mention above that FACTS could be used as electronic valves. While gating capabilities may be helpful for some applications in today's systems, their implications are not profound. Given the importance of economies of pooling and the free flow of electricity through the system, the existence of an electric valve, by itself, would not fundamentally change the structure of the industry. However, gating capabilities in conjunction with electric storage would have profound consequences for the system.[78] Specifically, this could open the door for the development of competing, non-utility transmission systems. The existence of electric storage would reduce, if not eliminate, the large economies of scale from capacity pooling. One could conceive that if strategically placed in conjunction with FACTS valves, superconductive storage would allow transmission companies to gate their lines and through their storage capability, serve their customers with high reliability. These technologies together would significantly reduce the economies of scale of system operation,[79] and would solve the problem of parallel line flows on competing transmission lines.

7.4.4.3 FACTS and WPT

Synergies between WPT and FACTS can also be seen. If WPT technology develops to the point that power can be beamed from one part of the country or world to another, problems could exist because the transmission systems in the sending and receiving locations would sometimes be remotely connected, if at all. The result could be serious problems in synchronizing power flows. Using current, non-FACTS technologies, it would be difficult, if not impossible, to synchronize disparate power flows on the near-instantaneous basis that would be necessary if WPT would used in place of spinning reserve capacity. However, FACTS could handle this problem. Thus, FACTS serve as an enabler of WPT's ability to make fundamental changes to transmission systems.

[78]In particular, see the discussion in Section 11.4.2 with respect to the technical impediments to competing transmission lines. If one could eliminate the need for the system to balance at all times, one could "gate" the system without sacrificing efficiency, and therefore allow for competition in transmission line service.

[79]Instead of system operators that pool all of the generating capacity in a region together, the transmission company (which could be in competition with others) would aggregate its own supply.

7.5 PROBLEMS IN FORECASTING TECHNOLOGICAL ADVANCE

This chapter has presented technologies and their predicted future uses in a rather matter-of-fact manner. While such a presentation may appear appropriate in several cases,[80] in general, doing so with the belief of being accurate is dangerous. With this being the case, let us attempt to gain a better understanding of the potential imperfections in the preceding analysis.

7.5.1 Implications for the Analysis in This Chapter

While this chapter has examined three technologies that are anticipated or speculated to have a significant impact on transmission systems of the future, it must be remembered that technological innovation (and predictions of it) is not a precise science. As a result, predictions about future technologies abound -- some prove correct while many others turn out to be wrong.[81] Just because the three technologies evaluated here appear to be leading contenders for future use, that does not mean that they will be used, that they will be used as predicted, or that they will be the most significant technologies introduced onto the grid.

Despite this "reality check," the preceding analysis is worthwhile. We can safely assume that there will continue to be innovations in transmission technologies. Given the importance of technological innovation in increasing economic efficiency, it is vital that the new industry structure accommodate, if not encourage, technological change. Even if these three technologies are not used on the system or are not the three most significant technological breakthroughs during the next several decades, evaluating their potential impact on the system can nevertheless be illustrative of the dynamic considerations that must be made in planning a future electric power industry.

7.5.2 Why is it Difficult to Predict Technological Change?

The previous discussion leads to an obvious question, why is predicting technological development, and commercial adoption of new technologies in particular, such an inaccurate endeavor? Why is it that "even the greatest ideas and inventions can flounder, whereas more modest steps forward can sometimes change the world?"[82]

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[80] This is most notably true of the semiconductor industry, where technological advance has proceeded in a remarkably predictable manner according to Moore's Law. But even in this case, where the development of the basic technology has been predictable, its use has been anything but predictable. For a more complete discussion of this see: Lester, Chapter 6, forthcoming.

[81] For example, see: "Futurist Schlock."

[82] Rennie, 1995, 57.

Rosenberg sheds some insight on the question when he concludes that there are four constraints on human thinking that lead to misjudgments of a new technology's ultimate value:[83]

- New technologies typically enter the world in a primitive condition;
- Their value is dependent upon advances in complementary technologies;
- Technological advances often create entirely new systems; and
- New technologies can identify human needs in a new context or in ways not previously articulated.

While this may be implied by Rosenberg, Paul David adds another significant caveat -- even when people recognize that a technology is valuable, it often takes time to understand how to employ it usefully. This was witnessed in his recounting of the story of the adoption of electric power in factories,[84] and is being witnessed today with regard to information technologies in today's productivity paradox. Along the way to the creation of a new technology paradigm, many paths may be attempted (i.e. specific technologies catch fire and then are replaced by better ones) before an accepted avenue develops. For example, if this thesis were being written in 1993 or early 1994, it may have concluded that the Wintel standard -- Intel-based personal computers, running Microsoft Windows™ -- would be the basis for the future information industry. However, only one or two years later, the paradigm has changed as attention has shifted to the Internet and the World Wide Web.[85]

Another source of unpredictability is the sheer amount of time that innovation takes, as Hogan recognizes,

> How fast does new technology penetrate? It takes a lot of time in the best of circumstances -- and one speaker said that typically regulated industries are the slowest to adapt. The transmission part of this industry is going to be regulated for a long time. We're talking 10 to 15 years down the road before we could start getting any significant inroads from things that are still on the drawing board.[86]

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[83] Rosenberg, 1994, 4-5.

[84] See Appendix J.6.4 or, perhaps, see describe and see David, 1990.

[85] Sources: "Microsoft Battles for Hearts, Minds of Software Makers;" "Nearing the $500 Computer for Internet Use;" "Stripped Down PCs Will Be Talk of Comdex;" "LSI to Unveil Chip Design for Building Inexpensive Machines to Access Internet;" and "Gold Rush in Cyberspace." The design of real-time information networks (RINs) for transmission systems (that would meet the Mega-NOPR's RIN concepts) is illustrative of this. The first efforts were to develop Windows™-based systems. At least seven competing systems were developed. Source: "Real Time Networks: A Peek at Tomorrow's Transmission Market." However, the RIN NOPR issued by the FERC in December 1995 calls for an Internet, World Wide Web based system. Source: FERC, 21 December 1995.

[86] Hogan, November 1995, 75.

In addition, surprises can develop along the long path from initial scientific discovery to commercial use. Chu concludes his discussion of the current state of superconductor research with the following,

> Although the pace of improvement has made workers optimistic, the existence of a technology alone does not guarantee it a major position in a market-oriented society. The cost-benefit factor dictates the outcome... Although unforeseen applications are certain to arise -- no one predicted that MRI technology would emerge from superconductors -- the high-temperature wonderland will most likely consist of subtle yet economically profound changes, a conversion of esoteric technology into instruments we can rely on every day.[87]

The important lesson from this discussion is that even if radically new transmission technologies -- such as wireless transmission or superconductivity -- emerge at some point in time, it would likely take some time for their value to be fully understood, and in turn, for the system to adjust. At first, they would likely be used as "replacement parts" on the system rather than the basis for a new network. As they become integrated with other technologies, their ultimate use may be close to what is discussed here, or may it look very different from what is projected in this chapter.

7.5.3 Other Technologies

One other important consideration is that these three are not the only technologies currently being developed that could have an impact on future transmission systems. One technology in particular -- distributed generation -- could do much to change the nature of the transmission system.[88] The basic concept of distributed generation is that electric power would be generated on the site of the load rather than in central stations. If this concept were to take hold as some predict, a grid might still be necessary for reliability reasons, but it would carry much less power than it does today,[89] which could render much of this thesis moot.[90] While perhaps the most likely candidate, distributed generation is not the only emerging technology that could revolutionize the industry and render asunder many of the assumptions of this chapter.

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[87]Chu, 1995, 165.

[88]Casten, 1995; Lamarre, 1993; Olesen, 1995. Development of small-scale turbogenerators that could be used for Distributed Generation is at a relatively advanced stage. Source: "Capstone Unveils Landmark Turbogenerator."

[89]Casten, 1995, 73.

[90]This would lead to a highly complex problem, where a system operator would still be necessary to maintain the reserve margin pool, but would be in a very weak position since grid users would only want power in emergency situations. In day to day operations, the system operator would be more of a nuisance than anything (in the eyes of the user).

7.6 CONCLUSIONS

Three prospective transmission technologies are examined in this chapter, each of which holds the potential of making significant improvements in the transmission system as we know it today. By increasing the carrying capacity of transmission lines, FACTS can defer or eliminate the need to build new lines -- and the financial and siting issues that go with new construction. FACTS would also enable gating of the transmission system. Superconductive transmission lines might allow for the development of larger power pools and make transnational power exchanges possible, through their elimination of resistive losses. However, they would not, by themselves, eliminate all of the important system constraints. Of potentially greater consequence for transmission systems is superconductive storage, which could undercut the fundamental assumption that electricity load must be met exactly by generation on an instantaneous basis. The benefits of wireless power transmission are less well understood, largely because of the nascent state of the technology. At the very least, WPT technologies would likely service areas that are currently too remote to be able to become connected to the grid.

While these technologies by themselves offer substantial promise for improving the technical and economic performance of transmission system, they offer the possibility of radically changing the system when they are used together. For example, the use of FACTS as electronic valves, combined with superconductive storage devices would allow for competition between transmission lines that would not impair the technical stability of the system.

These predicted benefits illustrate the importance of technological innovation in ensuring long-term efficiency improvements in transmission systems. Hence, policy-makers should make an effort to accommodate, if not encourage, technological development as they develop deregulation proposals.

The ability to predict the future is an important factor that is missing from this and all similar analyses. Technological development is not a precise science -- e.g. promising development projects can fail to meet their technical goals or can be undercut by new, unexpected technologies. What does appear certain, however, is that technological change has, and will continue, to play a vital role in the electric power industry and in the transmission segment as well. The importance, yet inexactness of technological development underscores the importance of developing a deregulated market structure that encourages, and certainly does not impede technological development.

Let us now shift gears and focus on one component of some of the deregulation proposals -- divestment -- and examine whether it is economically efficient.

Chapter 8
Is Divestiture an Efficient Option?

The utility industry has reached an intersection where all roads and vehicles converge. There are no stop signs or lights; no one is directing traffic. Industry drivers are going to have to size up the situation and make decisions that will determine the direction and destination of the future. About the only thing you can't do is apply the brakes.[1]

-- Stanley T. Skinner (1995)

8.1 INTRODUCTION

Utility divestiture of transmission or generation assets is given serious consideration, if not required, in each of the restructuring proposals evaluated in this thesis, as well as in other proposals that have been put forward by industry participants. Such major ownership changes could have implications for the efficiency of transmission systems. In this chapter we explore the rationale for divestiture and the mechanisms by which it could occur. We also develop and employ criteria that determine whether, or in what cases, divestiture would be efficient.[2] Let us begin by examining the question: why is divestiture being considered?

8.2 WHY DIVEST?[3]

There are several reasons why utilities might voluntarily, or be compelled to, divest some of their assets.

8.2.1 Alleviate Market Power

Many analysts believe that market power in transmission or generation could cause distortions in an emerging competitive generation market.[4] As a result, a utility could be requested to divest some of its assets in order to alleviate its market power, which would have arisen from its long-time status as a vertically-integrated monopoly.

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[1]Cited in: "Utility Asset Sales," 22.

[2]These criteria are largely based upon Michael Porter's *Competitive Strategy* frameworks.

[3]For a more extensive discussion of this topic, see: Navarro, 1995, 373-377.

[4]For a detailed discussion of transmission and generation market power considerations and the FERC's rulings with regard to a competitive wholesale market, see: Stafford, 1991, 298-311. While some differences would exist between wholesale and retail markets, many of the principles are similar.

8.2.1.1 Market Power in Generation

Currently, investor-owned utilities (IOUs) generate approximately 75% of the electric power produced in the United States.[5] Utilities usually produce this power in plants that are located within their decades-old service territories. As a result, there is often only one dominant producer of electricity in any given service territory.[6] This made sense when the industry was structured to capture the natural monopoly characteristics of generation. However, now that generation has lost its natural monopoly attributes, the domination of generating capacity by one company in a service territory, and/or several utilities in a larger region, is problematic. If a "competitive" market were to be created by a policy decision to make generation prices market-based without consideration of market power issues and without the existence of viable competitors, the incumbent utility would often possess substantial market power, which could pose as a serious roadblock to the emergence of a truly competitive generation market, thus reducing the market's economic efficiency.[7] While the ability to economically transmit electric power across service territory boundaries would act to alleviate the market power problem (through competition from neighboring utilities), the grid, as it is currently built, was not designed to handle massive quantities of wheeled power.[8] Consequently, transmission constraints could limit the ability to mitigate market power through wheeling. The East Coast would be the most likely exception to this because the PJM, New York, and New England Power Pools have been designed for extensive power sharing. However, these "tight" power pools are much more the exception than the rule. And even on the East Cost, significant transmission constraints exist with regard to importing power into the region.

The experience of the United Kingdom demonstrates the importance of ensuring that market power is reduced (if not eliminated) and that a viable competitors exist before generation prices become market-based. Upon privatization of the United Kingdom's electric power industry, two private companies, National Power and PowerGen, produced three-quarters of the UK's power,[9] with much of the rest produced by the government-owned National Nuclear. Not surprisingly, the two private companies have earned oligopolistic profits overall,[10] and on occasion have been able to reap windfall profits by

[5] Energy Information Administration, November 1995a, 1.

[6] In some areas there may be several, due to jointly owned plants. Also, areas located on the boundaries of service territories could also have several close generators.

[7] See: FERC, 1989, 84-85; Moskovitz and Foy, 1994; and Section 9.2.2.3.1.

[8] Kelly *et al*, 1987, 1. Transmission capacity enhancements, in particular, as well as expansion, could alleviate this constraint on market power reduction.

[9] Chou, 1995, 71, 88.

[10] Chou, 1995. Prices from the British power pool shot up 46% between 1990 and 1994 according to a *Wall Street Journal* article. Source: Holden, 28 November 1995A11.

substantially "gaming" the pool.[11] Therefore, based on economic theory and experience, generation market power is clearly an important consideration when attempting to create a competitive generation market.[12]

One potential solution would be to forbid utilities from constructing new plants until the market power problem is mitigated. New entrants (who would emerge with rising demand) would dilute the market power in a region. However, due to the slow growth rate in the demand for electricity, even if all new power plants were constructed by non-utilities, the industry could remain essentially a vertically integrated one for many years, dominated by today's utilities.[13]

Another option for mitigating generation market power would be to force utilities to divest some or all of their generation assets.[14] Presumably, if generation market power mitigation is the only goal of divestiture, utilities should be allowed to keep some of their assets while selling off others,[15] since transferring ownership of all of the assets to another company would merely change the market power's source, rather than alleviating its existence. A further implication is that those assets that would be divested should be sold off on a plant-by-plant basis or in small blocks.

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[11]Tabors, 29 October 1995. Some argue that cooperative gaming would occur should the California POOLCO proposal be adopted. See Michaels, 1994, 64-65.
[12]Hogan, November 1995, 52; and "Almost There in California Restructuring."
[13]Joskow, 1995, 64. Paul Levy might dispute this claim, since the new entrants would be able to use new, lower-cost technologies. He states, "we accept and adopt technological innovations in other areas. We dispose of old computers and telecom gear while they are still highly useful because we can buy more efficient products at lower cost. Likewise, are we at the point that it is worthwhile to mothball many older power plants and replace them with new efficient ones?" Source: Levy, 1996, 89. One would expect that once real competition enters into the generation segment of the industry, more efficient ones will be built to replace, older, less-efficient ones. In contrast, the current industry mind-set is to use assets until they are fully depreciated (and beyond). It is from this perspective that Joskow concludes that market power could not be alleviated for years by new, non-utility capacity. However, until a competitive market develops and investors behave as Levy anticipates, it would not be responsible public policy to *assume* that non-utilities will build a sufficient number of new plants to eliminate market power. For example, there may be some unforeseen barriers to entry that would accompany a large increase in the use of new technologies. One could wonder if there would the natural gas supply or price would create constraints. If an insufficient number of new plants would be built, and until these new plants are built, monopolies would be able to reap supereconomic profits (although them doing so would likely hasten the arrival of new, lower-cost IPP plants). The Mega-NOPR would not require this. It only calls for functional unbundling.
[14]This route was chosen in the California Final proposal, which requests that Southern California Edison (whose parent company now is Edison International) and Pacific Gas and Electric sell 50% of their fossil generating capacity. These two utilities recently submitted proposals for doing so. Source: "Edison International, PG&E to Auction Some Power Plants."
[15]CPUC, December 1995.

8.2.1.2 Market Power in Transmission

Another potential problem is that transmission-owning generating companies could utilize their transmission market power to give them an unfair advantage in a competitive generation market.[16] According to one FERC Commissioner, "the FERC has consistently identified transmission market power as the key stumbling block to competitive generation markets."[17] The concern is that when transmission owning utilities (TOUs) also own generation assets in a competitive generating market, they could stifle competition by blocking access to transmission "bottleneck" facilities. This could be done either through an outright refusal to wheel "competing" power or by setting rates in a manner that gave its own generation sales a price advantage.[18] Although the Energy Policy Act of 1992 (EPAct) attempted to eliminate the ability of utilities to block transmission access, TOUs still partially retain this capability. For example, unless a utility has open access tariffs,[19] wheeling rates must be set on a case-by-case basis through the rule-making channels of the FERC.[20] This process takes time, and also allows an opportunity for the utility to selectively choose rates. The selective rate choosing practice is now being curtailed through the FERC's "golden rule" comparability standard, by which utilities must offer the same services and prices to others that they charge themselves.[21] Furthermore, the time it takes to process a rate case acts in the utility's favor. While a utility may not be able to block competition forever, it can use the tools at its disposal to stall (and make money in the process). This time delay is not trivial. For example, it took the FERC more than a year and a half after the passage of EPAct to make its first order to mandate wheeling.[22] The net impact is that society experiences an efficiency loss when a TOU exercises its market power to delay or eliminate (in the case of a short-term opportunity) a transaction that would otherwise be economically efficient.

The FERC's recognition that the good faith of TOUs cannot be relied upon in the development of efficient, competitive generation markets led to the issuance of the March 1995 Mega-NOPR. In it, the FERC stated, "unquestionably, this market power is still being used today, or can be used, discriminatorily to block competition."[23] While the

[16]Source: "The Regulatory Experiment."
[17]Santa, 1995, 16.
[18]For details of specific cases, see: Rogers, 1994, 6.
[19]As of FERC's 29 March 1995 Mega-NOPR, only 21 utilities had open access tariffs. Source: FERC, 1995, 17671.
[20]In fact, the FERC does not have the resources to handle every case where disputes arise over transmission access and pricing. Source: "Scherman to Electrics: Put Order 636 On Agenda."
[21]Sources: "Landmark FERC Decisions Rock Industry."; and Falcone, 1995.
[22]Source: "Landmark FERC Decisions Rock Industry."
[23]FERC, April 1995, 17664.

Mega-NOPR does not mandate divestiture of utility assets, it does require the "functional unbundling" of generation and transmission assets.[24] In essence, functional unbundling means that a utility's generation and transmission assets must be operated separately and independently, as if they were separate companies, even though they share a common ownership.

Some market analysts and participants believe that it is inappropriate for the same firms to own both competitive generation and bottleneck transmission facilities, even if they are functionally unbundled. As a result, there is a growing pressure on regulators to require utilities to divest some or all of their generation[25] or transmission[26] assets. Scott Hempling, a lawyer who represents a group of IPPs, lists a number of advantages to compete corporate unbundling,

> The cleanest solution [to this potential problem] is to have the transmission assets owned and operated by an independent company. Then there's no conflict of interest, no risk of cross-subsidy, no people who are denied promotions because they have elevated the public interest over their own company's interest.[27]

The counter argument is that functional unbundling should be sufficient, and since it is less severe and is more flexible than immediate divestiture, it should be given a chance. "Corporate unbundling is unnecessary if functional unbundling can achieve the goals of comparability."[28] If not, functional unbundling can be turned into corporate unbundling at a later date. The issue of utilities divesting assets in order to alleviate market power is one that will likely take several years to resolve.[29]

While market power alleviation is a long-run economic efficiency-based reason for asset divestiture, there are near-term reasons for considering divestiture too.

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[24]FERC, April 1995, 17681-17682.

[25]Joskow, 1995, 64; Howe, 1994, 71; Knight, 1995; "Looking for Landmines in FERC's 'Mega-NOPR'," 13; "PSI's Rogers, LGE's Hull Float Radical Transmission Plans;" and "AES: Real Reform Requires Splitting Generation from Transmission and Distribution."

[26]Houston, 1992; "PSI's Rogers, LGE's Hull Float Radical Transmission Plans;" and "MGE Asks FERC to Set Utility Divestiture of Transmission."

[27]Source: "Looking for Landmines in FERC's 'Mega-NOPR'," 13.

[28]Woychik, August-September 1995, 78. See also: CPUC, May 1995, 12.

[29]For more discussion of the issue, see Santa, 1996, 32-33.

8.2.2 Ameliorate Stranded Investments

One of the most contentious issues in the industry restructuring debate is that of stranded investments (SIs).[30] While a consensus on dealing with the issue is still far-off, two potential ways of handling it involve asset divestiture.

8.2.2.1 Determine Value of Stranded Investment

Some analysts believe that the only equitable manner by which the "true" value of stranded investments can be calculated is through a market-based mechanism, specifically, for the stranded assets to be divested.[31] The difference between the embedded cost of the assets and price the utility receives for them would be the total stranded investment, for which the utility would be partially or fully compensated.[32] Mathematically,

$$\mathrm{SI} = \sum_{i=1}^{n}\left(EC_{Ai} - MV_{Ai}\right) \qquad \text{(Equation 8.1)}$$

where:

n = number of assets
EC = undepreciated embedded cost of A*i*
MV = market value of A*i*

The underpinning of this argument is that because these investments are being stranded by market forces and because the industry is becoming market-based, the only accurate (and efficient) manner of determining the value of stranded investments is through the market.[33] Often those arguing this position assert that utilities who wish to receive stranded investment payments would be required to sell *all* of their generating assets, so that utility customers would receive the benefits from those assets sold at a super-embedded cost price.

8.2.2.2 Pay Off Stranded Investments

A second option would be for a utility to sell its transmission assets in order to pay off its stranded investment in generation.[34] The transmission assets would be sold based upon the

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[30]See Section 3.7 for more details.
[31]For a discussion of this, see: Knight, 1995, 59-64.
[32]Calculating stranded investments would not necessarily mean that the utility would receive 100% compensation, however. Recent advocacy for this idea is found in: "ELCON Offers Stranded Cost Compromise;" "GMP Wants Resource Auction to Determine Stranded Cost;" and "Green Mountain Auction Plan Wins Kudos." The May 1995 CPUC decision mentions this, but does not advocate it. Source: CPUC, May 1995, 12-13.
[33]Source: "AES: Real Reform Requires Splitting Generation from Transmission and Distribution."
[34]For example, see, for example: Moskovitz and Foy, 1994; and Wright, 1995. This is further described, but not espoused by: McDiarmid, 1995.

assumption that their embedded cost value is well below their market value.[35] Proponents argue that these assets could be sold at a market value large enough to offset some or all of a utility's stranded generation investments.

This strategy is not without risks, however. One risk would be that the predictions are wrong and that the utilities would not receive enough above-embedded cost revenues from the sale of their transmission systems to compensate for their stranded investments. This could occur for at least two reasons: the inherent value of transmission assets minus their embedded costs are less than the stranded generation investments; and capital markets could be unwilling to invest tens, if not hundreds, of billions of dollars[36] in an industry that is currently fraught with uncertainties as it moves through a transition state.

The converse (although unlikely) risk is that utilities could receive too much for their transmission assets. If transmission assets were sold at artificially high prices so that utilities could recoup generation stranded investments, the new owners would need to charge super-economic transmission fees.[37]

8.2.3 Utilities View Divestiture As A Strategic Move

A utility could view divestiture as a strategic decision. For example, a utility could choose to divest generation in order to focus on perceived core competency strengths in T&D or because of an internal expectation that T&D would be more profitable.[38] Regardless of the reason, utilities do not appear to be wedded to the notion that they will remain vertically integrated forever. In a 1993 survey of 41 electric utilities, less than half viewed generation as "central to their mission."[39] Forty percent of the utilities responding to a 1994 survey indicated that they believe that their generation function would be spun-off.[40]

While completely leaving a segment of the industry such as generation is one option, full divestiture need not be the only course of action. A utility may wish to sell specific assets

[35]Largely due to relatively high construction costs and the significant difficulty of siting a new line.
[36]The current embedded cost of transmission assets is approximately $57 billion. Estimates of stranded investments range from $20-$200 billion. Sources: Energy Information Administration, January 1993, 47; and Baxter and Hirst, 1995.
[37]McDiarmid, 1995, 43.
[38]Wagener, 1995; and Gottlieb and Colucci, 1995, 63. In a recent survey, senior utility executives were asked if they were forced to unbundle, which segment of the industry would they stay in? Distribution was the choice of 57%, generation 28%, and transmission 15%. Source: "Vanishing Act."
[39]Homola *et al*, 1994, 66.
[40]Doughty and Rode, 1995, 24.

for reasons that include: a desire to unload a high-cost project, an escape mechanism from a high-cost fuel or labor contract, and an attempt to receive value from a mothballed asset.[41] Strategic divestment is already beginning to occur. For example, Pacific Gas and Electric (PG&E) has announced plans to sell off several hydroelectric projects and Commonwealth Edison[42] and Dairyland Cooperative are selling off large coal plants.[43] The most radical move was recently proposed by Niagara Mohawk Power Company. This embattled utility proposed, among other things, that it would sell its nuclear plants to the State of New York Power Authority and that it would split itself into a generating and a T&D company.[44] Agis Salpukas, who extensively covers the industry for *The New York Times*, commented,

> [Niagara Mohawk's proposal is] the most far-reaching example so far of the new strategies utilities nationwide are adapting in response to a rapidly changing competitive environment... [The proposal] could be a model for other utilities to follow as the industry undergoes a profound shift from state-regulated monopolies to a new era of competition for power.[45]

8.2.4 The Reality

For a combination of the reasons above, it seems clear that some, if not all utilities will eventually undergo some divestiture.[46] The industry's understanding of this reality was captured in a recent survey, where only 17% of the responding utilities thought that they would retain their "traditional" functions of generation, transmission and distribution.[47] Another recent survey, this time of 42 state public utilities commissions, found that 40% of them expect electric utilities to unbundle transmission from generation before the turn of the century.[48] Yet another survey, this time of 91 state commissioners and 41 executive staff members (of commissions) found that, "[respondents, by] a two-to-one margin saw unbundling as being in the customers' best interests."[49] These bits of information support the likeliness of eventual divestiture. With this being the case, let us now examine how divestiture would occur.

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[41]Boddington, October 1995, 20.
[42]Source: "ComEd Puts Two Plants on Block."
[43]Boddington, October 1995, 20.
[44]Source: "Niagara Unveils Proposal to Split Electric Utility."
[45]Salpukas, 7 October 1995, 35, 39.
[46]Radford, 1995.
[47]Doughty and Rode, 1995, 24.
[48]Source: "Will IOUs Unbundle by 2000?"
[49]Source: "S&P Survey: Industry May Need Preemptive Transition Rules."

8.3 HOW WOULD DIVESTITURE OCCUR?

8.3.1 Impetus

8.3.1.1 Voluntary (Purely)

The first, and least contentious impetus for divestiture is that a particular utility would come to believe that divestiture is in its (and its stockholders') best interest. While almost unheard of in the electric power industry, these moves occur frequently in the larger American economy. During the first seven months of 1995, 26 major companies spun off assets with a market value of $16.7 billion. Included in this was the quintessential conglomerate: ITT.[50] Later in the year, two members of the Dow Jones Industrial Index, AT&T and 3M, also split up.[51] In the three mentioned cases, the companies plan to split up by giving their shareholders stock in the "parent" and "offspring" companies that will emerge after divestiture. A common thread in each case was the intent to split the company along functional lines (keeping together the parts that are common) and along profitability lines (freeing high margin business units from poorer-performing ones). There are significant parallels in these examples to the predicted voluntary divestiture in the electric power industry. With the exception of a partial divestiture of generation assets, electric power divestiture would mean splitting the company along functional lines (generation, transmission, and distribution); and if done voluntarily would likely result in the low margin (generation) assets being separated from higher margin ones (T&D).

A less rosy scenario could also cause voluntary divestiture. Most experts suggest that there will be a shakeout in the utility industry, with bankruptcies and "a clear separation of the market into winners and losers."[52] Companies do not tend to go bankrupt without a fight; instead, they tend to sell off assets until only a shell of their former selves exist. Therefore, it is likely that as utilities begin to experience financial duress, they will begin to sell off assets "voluntarily" in acts of desperation.

8.3.1.2 Quasi-Voluntary: "carrots and sticks"

The second impetus would also be "voluntary," but it would result from "regulatory duress." In a regulated industry, regulators have many sticks and carrots at their disposal, even in cases where they lack the authority to compel action. For example, in the natural

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[50]Source: "The Whirlwind Breaking Up Companies."

[51]For example, see: "3M Moves to Boost Profits;" "Minnesota Mining to Spin Off Units, Take Major Charge and Cut 5,000 Jobs;" and "AT&T Has The Plan Is Mandl the Man?"

[52]Source: "Gale: Beware the Permanent MW Surplus." Also see: "States: Utility Bankruptcies Will Increase."

gas industry, "voluntary" functional unbundling occurred under Orders 436 and 500.[53] Likewise, prior to the passage of EPAct, the FERC did not have the authority to mandate open access to electric power transmission systems. However, during the late 1980s and early 1990s, the FERC used carrot and stick mechanisms during its review of proposed mergers and proposals for market-based pricing of wholesale power transactions to pry open the grid, at least on a limited, case-by-case basis.[54] The FERC likely finds itself in a similar situation with regard to asset divestiture, in that it does not have the authority to mandate divestiture. FERC Commissioner Donald Santa noted, "I believe that the FERC can not directly force divestiture. But it can encourage utilities through a combination of 'carrots and sticks'."[55] While the FERC may not have the power to force divestiture, state commissions might.[56]

8.3.1.3 Mandatory

If some regulatory bodies (presumably state commissions) do in fact have the power to do so, the most extreme form of government intervention would be the forced divestiture of some utility assets. This option, albeit severe, is a genuine possibility since two of the proposals that we are evaluating call for such a move, a third leaves it open for consideration, and a fourth is silent on the matter. Only the FERC Mega-NOPR explicitly does not call for such a move (although the FERC does not have the authority to do so). Because mandatory divestiture would likely be contentious and litigious, the carrot and stick approach is a preferable approach.

8.3.2 Mechanisms of Divestiture

There are at least three mechanisms by which divestiture could occur.

8.3.2.1 Spin-Off

The first of these would be to "spin off" the assets to shareholders in the form of a new corporation. Shareholders would receive shares in the "pieces" of the companies that result.[57] As mentioned above, this method was the option chosen by AT&T, ITT and 3M; as well as by numerous other companies.[58] A spin-off would be a good move for a utility

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[53]For a more complete discussion of this, see: Section 6.3.5.2.
[54]Joskow, 1994, 26; Houston, 1992, 51-53; Kelly *et al*, 1990, 56-58; and Hall, 1991.
[55]Santa, 1995, 18.
[56]Their exact powers could be questioned. It should be noted that the states could also use a carrot & stick approach.
[57]See, for instance: CPUC, May 1995, 13.
[58]Also see: "And Then There Were Two;" and "The Whirlwind Breaking Up Companies."

that is seeking to separate its high-margin business from low-margin ones. On the other hand, if a utility were looking for a cash infusion from divestment to pay for stranded assets, a spin-off would not be a desirable move.[59] This is because any financial benefits that occur from the spin-off go directly to the shareholders instead of the company's balance sheet.

8.3.2.2 Auction

A second option would be to sell-off some or all of the pieces of a utility through an auction procedure. Presumably, the auction and its details would be developed and implemented through extensive negotiations between the state commission and utility. These negotiations would be important, because the auction rules (e.g. floor/ceiling prices, bidding eligibility) would play a large role in the ultimate "success" of the auction. While the utility would likely run the auction, there would undoubtedly be close surveillance by the commission, especially in cases where its proceeds would be used to calculate or compensate for stranded investments.

8.3.2.3 Negotiated Sale Agreement

The third option would be for the utility to conduct its own selling process and come to a sales agreement on its own terms with a suitor. Utility management would spend months hammering out an agreement, which would be made public only when the details are settled (although "leaks" occur frequently). This is the mechanism by which most companies are sold. In general, this method has its advantages. For example, "typically, a buyer will want to talk confidentially with the seller to ensure that the plan is realistic and meets the seller's needs."[60] Likewise, the existing management would be given more of an opportunity to protect "important" cultural aspects of the business, as well as discretion with regard to intangible values, such as: the buyer's name and reputation, post-sale treatment of current employees, the future of current management.[61]

If transmission assets are divested in order to alleviate market power (and not to pay-off stranded investments), a negotiated sales agreement would probably be the most likely mechanism -- especially since the likely buyer would be a regional transmission entity. Hence, with only one potential buyer, closed-door negotiations would not be frowned

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[59]Unless an approach like AT&T's was taken. While shareholders received many of the shares in Lucent, its telecom equipment spin-off, AT&T also offered shares in the new corporation through an initial public offering which netted three billion dollars. Sources: "How Glowing is Lucent's Future?;" and "Lucent's Initial Offering Net Record $3.025 Billion."

[60]Boddington, May 1995, 76.

[61]Porter, 1980, 354.

upon. However, if a utility were selling its generation assets and the sale's proceeds would be figured into a stranded investment charge, such a mechanism would likely be unacceptable. Presumably the public and its agents (the commissions) would demand a totally open, level-playing field mechanism -- either a spin-off or a closely-monitored auction.

Until now we have discussed both spin-off and sale divestitures. Much of the remainder of the chapter will focus on the latter -- auctions and negotiated sale agreements -- because they would be mechanisms for stranded investment recovery and they can be evaluated by the paradigm that is developed and used later in the chapter. Having now examined the whys? and hows? of divestiture, let us examine the question: what would make such a move economically efficient?

8.4 WHAT WOULD MAKE DIVESTMENT EFFICIENT?

We develop two criteria to evaluate the efficiency of divestiture.

8.4.1 Prices Received Should Be "Correct"

The first criterion is that the price received from utility asset divestment should be economically "correct" -- it should reflect the "true" inherent value of the assets. We make the assumption that this would occur in a perfect "market" for companies.[62] Purchase price distortion in either direction would have an impact on the efficiency of the restructured industry. If the purchase price was too low, the utility would have its financial integrity compromised and would be unnecessarily weakened in the market segments where it retains its assets. Charles Studness comments, "If a utility cannot raise needed capital because its financial condition is compromised, the quality of service provided to customers suffers."[63] On the other hand, if the price received were too high there would be several problems. First of all, if this price distortion resulted from a mandated sale price floor, there might be a dearth of investors willing to buy the assets. Secondly, the prices that the

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[62]Michael Porter describes these markets as follows. "The market for companies is the marketplace in which owners of companies (or business units) are sellers and acquiring companies are buyers. In most industrialized nations, particularly the United States, the market for companies is a very active market in which many companies are bought and sold every year. The market is well organized, involving finders, brokers, and investment bankers all seeking to match buyers and sellers and often reaping large commissions for doing so. The market has become more organized in recent years as both intermediaries and participants have become more sophisticated. Intermediaries now work actively to generate multiple bidders for selling firms, and multiple bids are common." Source: Porter, 1980, 350-351.

[63]Studness, January 1994, 32. Paul Levy makes a similar argument, in the context of stranded investments. "The financial ruin of many electric utilities ... would not provide a reasonable foundation for a future that will require significant investment. Rather, it seems desirable to have most of these companies be vital participants in the new marketplace..." Source: Levy, 1996, 88.

entity would have to charge to recoup its investment would be higher than the most efficient price for the provision of electricity service.

However, to expect that the "economic" price would be paid for all assets is wishful thinking. Imperfections exist in "mature" asset "markets" and are heightened in emerging asset markets -- such as the "market" for electric power assets. As one participant in the business mentions, "while the market for generating assets is active, it is also imperfect. Buyers and sellers are not numerous, nor are projects homogeneous. Information differentials exist and barriers to entry are real."[64]

In this chapter, the "correct price" efficiency condition is tested through the use of Michael Porter's *Competitive Strategy*[65] framework with regard to acquisitions.[66] Porter's acquisition framework is designed to identify imperfections in asset markets since they can lead to "successful acquisitions."[67] Porter takes this viewpoint because the book was written to aid a prospective buyer in making an economically favorable acquisition. Thus, by finding the favorable conditions for an acquisition according to Porter's framework, we can identify features of proposals that would make them economically inefficient from the societal perspective.

8.4.2 Market Power Would be Alleviated

A second criterion for evaluating the efficiency of divestiture sales is that market power in the resulting industry structure should be alleviated.

Let us next examine the concept of competitive strategy.

8.5 COMPETITIVE STRATEGY

8.5.1 What Is It?

All firms have a strategy, or strategies for carrying on their business, whether they be implicit or explicit. The academic study of competitive strategy is an attempt to rationalize these strategies by providing an analytical framework for their development. A classic work on the topic is the 1980 book by Harvard Business School Professor Michael Porter entitled, *Competitive Strategy: Techniques for Analyzing Industries and Competitors* .[68] In

[64]Boddington, 1995, 75.
[65]Porter, 1980.
[66]This is explained in more detail in Section 8.5 and Appendix G.
[67]Porter, 1980, 353.
[68]Porter, 1980.

it, Porter presents "a comprehensive framework of analytical techniques to help a firm analyze its industry as a whole and predict the industry's future evolution, to understand its competitors and its own position, and to translate this analysis into a competitive strategy for a particular business."[69] Porter does this through a series of frameworks for analyzing a wide range of strategic decisions that firms must make -- whether to enter a new industry, how to deal with fragmentation, and how to operate in (or exit) a declining industry.

8.5.2 How Will It Be Used?

In our analysis we utilize two of these frameworks, acquisition and entry, for both transmission and generation. The reason for doing the acquisition analysis is that we want to know the conditions by which divestment through a sale would be efficient. There are two motivations for performing the entry analysis. The first is that one method of eliminating market power would be through entry. Thus, this evaluation should tell us if there are any circumstances in which it would be realistic to eliminate market power by the "natural" process of entry instead of the more painful process of divestiture. The second motivation is rather utilitarian, the entry analysis is the first step in performing the acquisition analysis in Porter's framework.

8.5.3 Limitations of Porter's Framework

As is true of any theoretical framework, competitive strategy has some limitations. In the process of completing the analysis in this thesis, several of these rose to the surface.

8.5.3.1 Input Assumptions

The first limitation is that the results are relatively sensitive to input assumptions and conditions. This problem is compounded because the framework does not tend to reveal important inputs that may be overlooked. For example, in our analysis of the electric power generation industry, the framework does not prompt consideration of the existence of surplus capacity.[70] If one does not designate capacity surplus as an input condition, the analysis is performed without it, which could lead to poor strategic decisions. Additionally, when performing the analysis in the electric power industry, the framework is of little assistance in helping to determine who the potential competitors might be despite the requirement that the analyst must identify potential competitors *ex ante.*

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[69] Ibid., xiv.

[70] An important consideration in the electric power industry analysis because of the durability of facilities and low demand growth rate.

8.5.3.2 Conceptual Stretching[71]

A second problem encountered when applying Porter's frameworks is that they are designed for use in competitive industries that have homogeneous national markets, rather than in the Balkanized monopoly structure of the electric power industry. In contrast, our analysis attempts to use the framework to identify favorable areas and conditions in a spatially heterogeneous market. Furthermore, while the generation segment of the industry is becoming competitive, its initial state in the analysis is not competitive; and the transmission segment is definitely not competitive, nor do any of the proposals envision anything but a monopoly transmission market.

8.5.3.3 Neglect of Regulation's Impact

A third weakness of Porter's frameworks, at least when they are applied to a heavily regulated industry such as electric power, is that it does not have provisions for actions that are mandated by regulators. They assume that market forces, not regulatory *fiats*, guide the industry. In order to accommodate regulatory decisions, we explicitly insert these considerations into our analysis.

8.5.4 Continuing Utility of the Framework

Despite the imperfections of the *Competitive Strategy* frameworks that are detailed above, they retain beneficial qualities that make their use worthwhile. The first quality is that when capital is infused into the electric power industry, it comes from competitive sources. When deciding which industry to place their money in, investors have many options. Both frameworks are based upon this assumption, and the acquisition one in particular is much more geared toward this fact than it is toward the exact technology or market structure of the industry. Secondly, the frameworks are relatively useful when examining competitive industries, and since an underlying theme in this thesis is to understand how competition might develop in generation and transmission, the frameworks could help meet this objective. Thirdly, the intent of using the frameworks is to obtain a qualitative feel for the likely result of divestiture in terms of utilities receiving an "economic" price for their assets. As such, the intent is to gain insights on policy, not to develop quantitatively precise predictions.

[71]Thanks to David Reiner for providing terminology support.

8.6 APPLICATION TO GENERATION ASSETS

Let us now apply the frameworks to the generation segment of the industry.

8.6.1 Method

8.6.1.1 Entry Analysis

The first step in the analytical process is to ask and answer two questions regarding entry into the generation market in an area:[72]

- What characteristics would make an area a desirable location to build a retail merchant plant?
- What characteristics would make an area a desirable location to enter a competitive auction for wholesale power production?

From these questions we can observe several valuable insights which are discussed later.[73] In order to answer the questions, we perform analysis based upon the Porter "internal entry" framework.[74] This entry analysis is conducted in a series of stages.

The first step is to identify areas that would be desirable for entry using Porter's "Identifying Target Industries for Internal Entry" criteria.[75] The next step is to perform a structural analysis of the industry, attempting to identify characteristics that would make an area favorable, based upon Porter's structural analysis framework.[76] With these in hand, four points which Porter believes should be balanced[77] are analyzed. And finally, these are compared with six "generic concepts for entry" that Porter expounded.[78] From this analysis, a list of desirable characteristics for an area is found.[79]

8.6.1.2 Acquisition Analysis

The acquisition framework is a patchwork of four parts of Porter's book. The heart of the framework is found in the latter part of Chapter 16, it also draws upon concepts from Chapters 3 ("Framework for Competitive Analysis") and 9 ("Fragmented Industries"), as well as the first part of Chapter 16 (entry). While the acquisition analysis partially builds upon the findings of the entry analysis, the frameworks actually have little in common. This may seem counter-intuitive at first, but it is the result of the frameworks' very

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[72]An area is somewhat of a nebulous definition. Presumably this would be a state. The intent here is not to focus upon a specific area, but rather to identify what would make for an "ideal" area for entry in terms of the existing electric power industry.

[73]See Section 8.6.2.1.

[74]Further details on the steps involved can be found in Appendix D.

[75]Porter, 1980, 344-349.

[76]Ibid., 5-29.

[77]Ibid., 341-342.

[78]Ibid., 349-350.

[79]This overall process is similar in intent to "opportunities and concepts contour mapping" and "strategic choke point analysis." For more information, see: Dar, 1996, 33-34.

different purposes. The entry framework seeks to identify imperfections in the market for products while the acquisition one focuses on imperfections in the market for companies.[80] The common ground occurs when the acquisition framework builds upon the entry one by identifying industries and situations in which it would generally be favorable to have a business. For example, it would be more desirable to be in the semiconductor industry than in the blacksmith[81] business. But beyond the basic desirability of the industry in question, the acquisition framework seeks companies that would sell at a price that would provide a buyer with above-average profits (i.e. sold at a sub-economic price).

The generation acquisition analysis focuses upon answering a set of three questions:

- From the viewpoint of a current utility, in what situations would it be desirable to purchase the generation assets of another utility?
- From the viewpoint of a current IPP, in what situations would it be desirable to purchase the generation assets of a utility?
- From the viewpoint of an industry outsider, in what situations would it be desirable to purchase the generation assets of a utility?

From these questions we find underlying insights on the situations that would lead to efficient asset divestiture.

8.6.2 Findings

8.6.2.1 Entry Analysis

A detailed description of the analysis of the generation entry assumptions and results is located in Appendix E. We find that it would be most desirable to build a merchant retail wheeling plant in an area where:

- The state commission is open to allowing retail competition;
- The local utilities: have many dissatisfied customers, especially due to high prices; are not prepared for competition, nor have they undergone the changes necessary to compete effectively; or are saddled with old, inefficient plants;
- Stranded investment costs are not so high that significant relief would likely be sought and granted (which would be a barrier to entry), yet not so low that utilities can enter into the competitive era unscathed;
- The concentration of generators is likely to remain high (few new entrants will emerge);
- The potential exists for a significant cogeneration facility;
- The regulatory structure allows for the producer, not the consumer, to retain any benefits from economic inefficiencies;
- The entrant could create product differentiation due to the location of its other generation assets;
- Demand is growing relatively quickly;
- There are significant potential customers who are concerned about electricity prices but are not hyper-price sensitive (i.e. they would be willing to leave their

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[80]Porter, 1980, 353.

[81]Thanks to Anita Kafka on her help with this.

utility for significantly lower rates, but would not, in turn, leave the new entrant for marginal savings);

- The customer base is likely to be somewhat diverse -- there is not dependence on one customer or one large industry;
- "Easy" energy savings cannot be made -- DSM, etc. -- by potentially prime customers;
- The entrant might be able to create new market structures; and
- The entrant's management has business experience and contacts.

It would be most desirable to enter a competitive auction for wholesale generation when:

- The number of expected bidders is small;
- The number of expected "winners" is greater than one;
- The entrant has a knowledge of the local area and its processes;
- Uneconomical DSM and renewable energy projects are not given high priority according to the rules of the auction;
- The entrant could create a differentiated product; and
- The entrant could build a cogeneration unit -- either tied to a plant owned by entrant or a partner of it.

8.6.2.2 Acquisition Analysis

Next we examine the possibility of acquiring generation assets. The detailed findings of this analysis are located in Appendix H. There are four general findings that cut across the three different scenarios with regard to when a firm would be able to purchase utility generating assets at a sub-economic price:

- Divestment is forced by law;
- There are few potential bidders;
- A utility is in poor financial shape; and
- A generating company (utility) has managerial weaknesses compared to the competition.

The first three findings have policy implications, and the first two are directly relevant to divestiture.

The implication of the first finding is that if a state commission forces a utility to sell its generation assets it is quite possible that the utility would receive a lower than economic price for them. The second finding could either ameliorate or exacerbate the situation. The emergence of many buyers, especially those that Porter deems as "irrational,"[82] could act as a countervailing force to mandatory divestiture and result in the utility receiving an economic or even super-economic price. On the other hand, if few buyers emerge, the utility could find itself with a significant economic loss. If the utility is able to collect

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[82]These are bidders who have reasons for wanting the assets which transcend the pure bottom line -- or at least the bottom lines of other bidders. Reasons can range from purely emotional to being part of a strategy for growth to the ability on the part of a particular bidder to extract extra economic good out of an acquisition, for example, if the additional assets would lead to further economies of scale. Source: Porter, 1980, 355-356.

stranded investments, the public would find itself with the loss. Regardless of who pays the bill, the result is economic inefficiency. In evaluating the likelihood of having too many vs. too few buyers, it must be remembered that utility assets are quite expensive. In fact, it is estimated that only 5 to 10 non-utility generators are credible buyers for utility assets.[83]

The third, and less obvious policy implication from this analysis is that if utilities are not allowed to operate on a level playing field, economic inefficiencies may result. However, if it takes other economic inefficiencies to create the level playing field (significant action to return a utility to financial health), the trade-off may not be worthwhile.

8.7 APPLICATION TO TRANSMISSION ASSETS

We would also like to determine under what conditions it would be favorable for new participants to enter into the transmission industry segment, by constructing new assets or by acquiring those of a utility. It should be noted that these scenarios rarely, if ever, occur.

8.7.1 Method

8.7.1.1 Entry Analysis

Examining transmission entry is important because there is a concern that insufficient incentives for transmission construction would exist in a restructured industry.[84] By exploring the reasons that firms could enter into the transmission business, policy measures for enhancing the incentives could be discovered. This discussion is also be helpful for the discussion of non-utility transmission systems.[85] In order to do so, we examine the question:

- Under what conditions would it be favorable for a new entrant to build transmission capacity in the service territory of a utility that is not affiliated with the new entrant?

Although the question we evaluate for transmission is different than the two questions that we examine for generation entry, we use the same basic entry framework. Therefore, we do not re-explain it here.

8.7.1.2 Acquisition Analysis

We also examine the efficiency of purchasing of a utility's transmission assets. In order to do this, we examine three scenarios:

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[83]Boddington, May 1995, 75.

[84]See Section 9.6.2.4. This is collaborated by a recent survey of utility executives which found that only 15% would choose to stay in transmission instead of generation or distribution in an unbundled industry. Source: "Vanishing Act."

[85]See Chapter 11.

- Under what conditions would it be desirable for a new entrant to purchase a utility's transmission assets?
- Under what conditions would it be desirable for an IPP to purchase a utility's transmission assets?
- Under what conditions would it be desirable for a utility to purchase the transmission assets of another (utility)?

Once again, we use the same framework as we do for the generation acquisition scenarios; therefore we do not re-explain it.

8.7.2 Findings

8.7.2.1 Entry Analysis

A detailed description of the transmission entry assumptions and results is located in Appendix F. We find that under the following conditions, it would be favorable for an entity other than the local service utility to construct transmission capacity:[86]

- Local authorities are open to progressive regulatory policies;
- The state has a relatively easy transmission siting process;
- The cost of line construction, including compensation for environmental externalities, is relatively low;
- Transmission demand is growing relatively quickly -- whether it be in the immediate region or as a result of being located between regions with high electricity price differentials; and
- There are many distribution companies/aggregators and/or non-concentrated ownership of generators in the region.

Perhaps the most interesting finding, which has implications for the California debate on POOLCO vs. Bilateral, is the last one -- that there are many distribution companies/ aggregators and that ownership of generation is not highly concentrated. The basic finding is that increasing the number of potential transmission customers would increase the possibility of finding a sufficient customer base.[87]

It should not be surprising that entities that are attempting to build new transmission assets would find states where the transmission siting process is relatively easy and where there are lower costs for environmental remediation more favorable. While not startling, this finding could be significant. An implication is that transmission siting rules, which are typically not included in deregulation discussions, could play a role in determining the ability to build new transmission lines in the event that new capacity would be efficient. If sufficient incentives for new transmission construction exist, this consideration is likely a second order effect at best. However, if, as some predict, adequate incentives for new

[86]This is not the exhaustive list of conditions, others can be found in Appendix F. The ones listed here are those which have policy-making implications.
[87]Especially since there already is an incumbent that has a significant amount of capacity.

transmission capacity do not exist in the restructured industry, the ease of siting could be a non-negligible factor in the ability to efficiently expand the transmission system.

8.7.2.2 Acquisition Analysis

Located in Appendix I is a detailed description of the transmission acquisition assumptions and results. While the three scenarios find slightly different conditions under which the acquisition of transmission assets would be desirable for the varying types of firms, three conditions are consistent across the scenarios and have policy implications:

- Divestment is forced by law;
- There are few potential bidders; and
- A utility is in poor financial shape.

These three are similar to the set that we find for the generation acquisition case. Consequently, we come to the same conclusion -- that a state commission contemplating the forced divestiture of transmission assets should balance the possibility of not finding a significant number of bidders for the assets with the potential efficiency gains of a divested transmission system. This decision would probably be more perilous in the transmission case than the generation case. One reason for this is that while generation assets do change hands occasionally and a non-utility generation industry has been thriving for a decade and a half (and therefore a "market" for assets has been developed), little, if any such activity (and corresponding market) exists for transmission. Furthermore, because transmission assets would likely be sold to one entity in any given region, there would likely be even less of a "market" mechanism, and at first, there would be little precedence for price-setting.

8.8 MARKET POWER ANALYSIS

Our second criteria for efficient divestment is that it would lead to a reduction or elimination of market power.

8.8.1 Generation Assets

The five deregulation proposals that we examine have three classes of provisions regarding generation asset divestment. Let us briefly examine them and their efficiency implications.

8.8.1.1 No divestment

The FERC Mega-NOPR and the California POOLCO proposal do not require utilities to divest any of their generation assets (although the California POOLCO proposal calls for a monitoring of market concentration). Depending upon the state or region's specific circumstances, this approach could range from being reasonable to causing a significant market power problem. In an area where there are many utilities (low market concentration) and a large capacity surplus, this approach may be acceptable. However, if the ownership of generation assets is concentrated, this strategy could lead to serious market inefficiencies. The case in Great Britain exemplifies the problems that can occur in a highly concentrated market. Another factor that should be considered is the concentration of ownership of the "mid-merit order" generators -- those whose cost structures would have them operating at some times and not at others. Mid-merit order generators would essentially set the market price whether it be explicitly in a POOLCO arrangement, or *de facto* in a bilateral market structure.[88] If the market concentration is high in these middle cost generators there would be a large opportunity for gaming, especially in a POOLCO arrangement.

8.8.1.2 Partial Divestment

The California Final proposal suggests the divestment of 50% of Southern California Edison's and Pacific Gas & Electric's fossil-fuel generation assets. The process of partial generation divestment will partially determine its impact on market power. If a utility were to divest all of the assets in a block, the result would be a transfer of market power from the utility to the buyer. If, on the other hand, the divested generators were sold individually or in several blocks, there would be a substantial reduction in market power. The previous discussion on the concentration of marginal generators is also an important consideration with respect to the efficiency of partial divestment. It is important that these generators be in the hands of several companies, which likely means that some of them should be retained by the utility.

8.8.1.3 Complete Divestment

The California Bilateral proposal and Wisconsin Extreme model call for utilities to divest all of their generation assets. In California this could be through an auction, spin-off, or other appropriate method; in Wisconsin, the sale of generators would through an auction or sealed-bid process. As mentioned in the previous section, the manner by which divestment would occur would have important implications for the resulting efficiency. An additional, nontrivial problem with this approach is that it would require utilities to sell assets, such as nuclear plants, for which there may be little if any market. While the complete divestment approach would conclusively solve the market power issue, this benefit should be weighed against the loss of efficiency due to the likely inefficient sales prices of some assets.

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[88]CPUC, D.95-12-063, 99.

8.8.2 Transmission Assets

The five proposals essentially contain two options for the transmission system: functional unbundling (taken by three models) and structural unbundling (chosen in the other two).

8.8.2.1 Functional Unbundling

The three proposals that would lead to functional unbundling take two approaches. According to the Mega-NOPR, transmission-owning utilities would continue to own and control their transmission systems, but their wholesale sales agents would not have any access to information about the transmission system that was not available to any other generator selling wholesale electricity. This would be accomplished through the wholesale sales agents receiving their information from the same real time information network (RIN) to which others would have access. According to the California POOLCO and Final proposals, utilities would turn over the operation of their transmission assets to an Independent System Operator (ISO), who would operate the transmission system according to non-discriminatory rules.

Functional unbundling is the middle ground approach; it attempts to eliminate market power without the more serious step of forced divestment (and the potential efficiency problems that could accompany it). While functional unbundling would reduce market power (especially in the ISO approach), it would not guarantee the elimination of market power abuse.[89]

8.8.2.2 Structural Unbundling (Divestment)

The Wisconsin Extreme model and the California Bilateral proposal also take diverging approaches to structural unbundling. According to the Wisconsin model, the utilities would be required to sell all of their transmission assets to a newly formed, state-wide or regional Transco, which would operate them on a non-discriminatory basis. According to the California Bilateral proposal, the utilities would divest their generators; and while retaining ownership of their transmission assets, they would turn system operation over to an ISO.

The structural unbundling approach would eliminate any possibility that a transmission utility would use its market power to distort the generation market. However, the structural unbundling approach would raise the same types of trade-offs that complete generation divestiture would. In the California Bilateral proposal the trade-offs are identical, since

[89]For example, see: Hempling, 1995.

structural unbundling occurs through generation divestment. The Wisconsin Plausible Extreme model could be problematic with respect to garnering an efficient price for the transmission assets.

8.9 CONCLUSIONS AND IMPLICATIONS

From the analysis in this chapter we draw several conclusions and develop policy recommendations regarding the economic efficiency of divesting utility assets.

8.9.1 Forced Divestiture Would Likely Lead to Inefficient Sale Prices

The forced divestment of assets during periods of uncertainty (such as during the current industry transition) is predicted to provide a utility with sub-economic revenues. The policy implication of this is that "buying time" before divestiture, while attempting to correct for market power abuse in the interim, would be the most efficient approach. These policies are embodied in decisions such as the FERC Mega-NOPR and the California POOLCO proposal,[90] where functional unbundling occurs first (with the potential for being a permanent solution), yet is done in a manner that would easily facilitate asset divestiture should functional unbundling prove to be an ineffective solution to the market power problem or should utilities voluntarily chose that option.

8.9.2 This Can Be Mitigated

The negative impact of forced divestiture depends upon the particular local/regional situation. If, for some reason, there are a number of credible, interested asset buyers or there are buyers who are irrational -- who have strategic or emotional reasons for paying an excessive amount for assets -- the problems associated with being forced to sell during a period of uncertainty could be mitigated.

8.9.3 Market Power Is An Important Issue With Multiple Solutions

Experience in the British deregulation has borne out the importance of mitigating market power. There are a variety of strategies for dealing with market power. In selecting a strategy, trade-offs must be made between the risk of market power abuse and the amount of disruption incurred in the attempt to prevent abuse.

[90] See CPUC, May 1995, 48-49; and Section 5.5.4 of this thesis.

8.9.4 Careful Consideration of Market Power and Divestiture Issues Should Occur

The most significant implication of this chapter's findings is that the potential for sub-economic divestiture revenues is important to consider; but, at the same time, it should not preclude forced divestiture if a regulatory body has substantial reason to believe that serious market power problems would exist without some form of divestiture. In the absence of a careful examination of the number of serious buyers that could be expected to bid for utility assets[91] and of a serious study of the market power of utilities,[92] the more cautious approach of functional unbundling would appear to be the most efficient course of action, at least until the fears of market power abuses are borne out in industry practice. If these careful examinations are made, the restructuring decisions should be consistent with their findings.

Having now devoted several chapters to specific topics and lessons regarding economic efficiency, let us incorporate these into a fuller discussion of the issue as we develop criteria for evaluating the long-term economic efficiency of the five proposals.

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[91]However, it must be borne in mind that the number of interested buyers will likely outstrip the number of credible buyers as a result of the massive amount of capital that is needed to buy these assets -- especially if they are sold in larger blocks. Furthermore, if there is a large number of credible buyers for the assets, the sub-economic revenue concern would be diminished.

[92]The California Final proposal would seem to meet this criterion. The Commission studied the market power issue at length, and in the end only required Southern California Edison and Pacific Gas & Electric to divest some of their assets (it didn't require 100% divestiture nor did it require San Diego Gas & Electric to sell any of its generation assets, since it does not own enough capacity to have market power).

Chapter 9
Criteria for Economic Efficiency in Transmission

> *The statesman, who should attempt to direct private people in what manner they ought to employ their capitals, would not only load himself with a most unnecessary attention, but assume an authority which could safely be trusted, not only to no single person, but to no council or senate whatever, and which would nowhere be so dangerous as in the hands of a man who had the folly and presumption enough to fancy himself fit to exercise it.*[1]
>
> *--Adam Smith (1776)*

9.1 INTRODUCTION

In this chapter we develop the criteria for evaluating the restructuring proposals on the basis of economic efficiency in transmission, which is an important but rather intangible concept. This is done by combining an understanding of the industry's technical and structural details with economic principles. Because of its important role in improving productivity and increasing efficiency over time, we make a special attempt to incorporate considerations regarding technological change. We also place special emphasis on pricing, since it will be the conduit for signaling efficient behavior in a restructured industry. At the end of the chapter we put forward our efficiency criteria, which are based on efficiency issues that we identify during the course of the chapter as well as lessons which we have learned in the three previous chapters (lessons which are reidentified near the end of this chapter).

9.2 BASIC ECONOMIC PRINCIPLES OF ECONOMIC EFFICIENCY

We begin the process of formulating our criteria by defining economic efficiency. After defining it, we examine basic economic principles regarding economic efficiency in order to identify issues that should be incorporated into our criteria.

[1] Smith, 1937, 423.

9.2.1 Allocative Efficiency Defined

While economic efficiency is at the heart of economics and is intuitively understood by many, it is a somewhat intangible concept. In the briefest of terms, "efficiency means there is no waste."[2] A more formal definition states,

> Allocative efficiency is present when all markets are in long-run competitive equilibrium. Each good is produced as long as consumers value it more than the alternative goods that might be produced with the same resources. No unit of the good is produced if a more valuable alternative must be foregone, and if any reallocation of resources toward different goods or different combinations of goods ... would not benefit any one person without hurting someone else[3].

Although these definitions provide a conceptual background for understanding economic efficiency, they do not provide tangible criteria for evaluating restructuring proposals.

9.2.2 Allocative Efficiency and Perfectly Competitive Markets

9.2.2.1 Conditions for Perfectly Competitive Markets

The concept is more testable as a result of the nearly axiomatic relationship that economists establish between economic efficiency and perfectly competitive markets. This relationship has its roots in Adam Smith's "invisible hand" of economics, which states:

> one involved in the market "neither intends to promote the public interest, nor knows how much he is promoting it.... He intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and is in this, as in many other cases, led to promote an end which was no part of his intention.[4]

Consumer and producer surpluses are maximized[5] by three characteristics of competitive markets:[6]

- *Efficiency in Exchange:* Customers' trade-offs between types of goods are equal;
- *Efficiency in the Use of Inputs of Production:* Every producers' marginal rate of technical substitution of labor and capital are equal; and
- *Efficiency in the Output Market*:: The marginal rate of transformation between outputs equals the consumers' marginal rates of substitution.

In a perfectly competitive market, the simultaneous fulfillment of these three conditions results in a market clearing price equal to the marginal cost of producing the good or service at the supply and demand equilibrium quantity. This finding, in turn, is the basis for the economic principle that efficient production and consumption behavior are signaled by marginal cost-based prices.[7] Therefore, economists assume that efficiency occurs in a perfectly competitive market, and as a result, the latter can be used as a standard for judging

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[2] Samuelson and Nordhaus, 1985, 28.
[3] Gwartney and Stroup, 1987, 442.
[4] Smith, 1937, 423.
[5] Pindyck and Rubinfeld, 1992, 576.
[6] For more detail, see: Pindyck and Rubinfeld, 1992, 602-603.
[7] We return to marginal cost pricing issues later in this chapter.

market efficiency[8] (i.e. when a market meets the criteria for a perfectly competitive market, it is deemed to be efficient).[9]

9.2.2.2 Conditions for Perfectly Competitive Markets

With this being the case, we now ask, under what conditions is a market perfect? Unfortunately, answering this question holds some of the same problems as defining economic efficiency. However, headway can be made when the converse question is asked, what makes a market imperfect?

9.2.2.3 Impediments to Perfectly Competitive Markets

Economists have identified four general reasons for market failure (the inability of the market system to be perfect, and therefore, to attain ideal allocative efficiency):[10] market power, public goods, imperfect or asymmetries of information, and externalities. Let us now examine both the economic theory behind these categories and their implications for efficiency in electric transmission systems.

9.2.2.3.1 Market power

Market power exists when a firm has the ability to affect the price or quantity produced of a good or service. In its extreme, market power takes the form of a monopoly (a single seller) or a monopsony (a single buyer). Economists have found that prices are higher in a monopoly market than in a competitive one, and the quantity of goods produced is lower, which makes for a loss in allocative efficiency. Likewise, inefficiencies occur in a monopsony market because a monopsonist has some control over the price it pays for goods and purchases them in a quantity that maximizes its own net benefit:

$$\text{Quantity}_{\text{monopsonist}} = f\{\max(\text{utility}_{\text{monopsonist}} - \text{price})\}. \qquad \text{(Equation 9.1)}$$

In the electric power industry, utilities have been granted market power -- in the form of a franchised monopoly -- by the government because the resulting scale economy benefits have outweighed the market power losses (especially since the latter have theoretically been checked by price regulation). However, as technological innovation has reduced, if not eliminated, the benefits of a monopoly generation market, the regulation-controlled market power that once was beneficial, has become an impediment to efficiency. As a result, the

[8] Pindyck and Rubinfeld develop a "proof" of this, see: Pindyck and Rubinfeld, 1992, 572-602.

[9] In the real world, of course, this never happens. It is like the physicist who develops principles neglecting gravity, friction, etc. However, like in physics, it does provide a useful template for understanding phenomena.

[10] See: Gwartney and Stroup, 1987, 442; Pindyck and Rubinfeld, 1992, 603-670; and Samuelson and Nordhaus, 1985, 712-721.

reduction, if not elimination, of market power has become an important consideration in restructuring the industry. This is necessary in the generation segment in order to ensure that a truly competitive situation can occur. (When this does not occur, as has been witnessed in the United Kingdom, significant inefficiencies can result.)[11] Market power is also significant in transmission because the vertically-integrated structure of many incumbent utilities could thwart competition in generation. In fact, the FERC views transmission system market power as "the single greatest impediment to competition."[12] While market power can be diminished in the generation segment by either constructing new plants or selling-off some utilities' assets, the natural monopoly character of transmission prevents such solutions.[13] We therefore identify an efficiency issue -- transmission systems should continue to be regulated as long as they are natural monopolies, in order to minimize the economic inefficiencies that result from monopoly ownership.

9.2.2.3.2 Public/Collective Goods

A second source of market failure is public/collective goods, which have two important characteristics:

- Once produced, they can readily be provided to additional consumers at a negligible marginal cost; and
- Once produced, it is difficult (if not impossible) to prevent someone from consuming or using them (non-exclusivity).

A classic example is national defense. An investment is made to provide the citizenry with security. The cost of protecting an additional citizen is zero and all citizens are protected from outside attacks. Because people cannot be prevented from receiving the benefits from a public good, a "free rider" problem can develop (i.e. one receives benefit from the good without contributing to its costs).[14] The market failure is that public goods are not readily produced by market mechanisms since their non-exclusive character makes it difficult to recoup their costs.

The ancillary services and system control functions of transmission systems are in the domain of public/collective goods. For example, a system operator would be necessary whether there are 10 or 10,000 transmission customers in a control area, the incremental

[11] For a recent discussion of this, see: "Short Circuit."
[12] FERC, 7 April 1995, 17664.
[13] This is because of the unified character of the grid and important economies of scale. Source: FERC, 1989, 73. This same report lists six ways by which market power in transmission could be mitigated: customer self- generation, indirect competition, customer choice of mandatory access to firm service at cost-based prices and flexibly priced non-firm service, competitive joint ventures, direct competition of alternative transmission lines, and regulation. Source: Ibid., 109.
[14] Gwartney and Stroup, 1987, 689.

cost of controlling the system for an additional customer is negligible if not zero, and the benefits of system control are shared by all who use the system. In a vertically-integrated utility industry, the responsibility for providing system control is clear, as is the method of paying for it -- the utility is responsible for its provision and the cost is rolled into the bundled rate structure. However, if transmission systems no longer are the exclusive domain of vertically-integrated utilities, their responsibility and/or ability to fund system operation would be reduced, if not eliminated. At the extreme, no entity would have an inherent incentive to provide system operation, even though its provision is in the best interests of all. A resulting efficiency issue is that because of the existence of public goods in transmission, financial incentives (or structural provisions) should be established to ensure that these vital functions are identified and would be effectively provided in a restructured industry.[15]

9.2.2.3.3 Imperfect Information or Asymmetries Thereof

In a perfectly competitive market, all participants possess complete and symmetric information regarding the quality and price of goods and services. However, in the real world, this is often (if not always) untrue because complete information does not exist (it is imperfect for all) or because some market participants have more complete information (it is asymmetric). Information imperfections can cause customers to make "incorrect" purchasing decisions and suppliers to make "incorrect" production decisions, both of which are inefficiencies.

At least three impediments to perfect information currently exist in electric power transmission systems. The first is that transmission owners currently have greater knowledge of their systems (costs and loadings) than transmission customers (e.g. IPPs who wheel power over it). In the natural gas industry, a similar asymmetric information problem was alleviated through the functional unbundling of transportation supply and sales by pipeline companies (through Order 636). In this functionally unbundled system, pipeline companies' gas sales employees work in isolation from their operations personnel and are required to receive all of their pipeline information through the same mechanisms that a non-affiliated salesperson would receive it. The most significant information transfer mechanisms are electronic bulletin boards, which also reduce the asymmetry of information between pipeline operators and their customers. (The ability of pipelines to take advantage of an residual asymmetry they enjoy over their customers -- including their own sales force

[15] For a more thorough discussion of this topic, and the potential negative consequences of underfunding system control, see Appendix J.10.

-- should be mitigated by FERC regulation.) The electric power FERC Mega-NOPR[16] and proposed rulemaking for real-time information networks[17] are steps toward reducing information asymmetries.

A second (future) source of information imperfection in transmission systems is that even if transmission utilities currently possess "perfect" knowledge of their systems; the information that would need to be "known" in a competitive, unbundled electric services industry would be different (and greater) than in today's bundled structure. The change in necessary knowledge stems from two sources. First, there is not a clear theoretical grasp of what information would be needed to perfectly understand the system and run it in a perfectly efficient manner, or even an understanding of what industry framework would facilitate these conditions. Secondly, even if a framework and the theoretical economic tools to decipher the information necessary to fully understand the system were developed; it is quite likely that the technical tools necessary to provide sufficient information would not exist (at least at a reasonable cost). Although the increasing capabilities of microprocessors are rapidly reducing technological limitations, technology-based information imperfections will likely continue for the foreseeable future.

Thirdly, even if the theoretical debates are resolved and sufficient technology exists, it may not be economically worthwhile to know all that would be needed to known in order to meet the perfect and symmetric information criterion. The costs of metering, information reporting, and mitigation processes could well offset the benefits of perfect information.

9.2.2.3.4 Externalities

Externalities occur when "a consumption or production activity has an indirect effect on other consumption or production activities that is not reflected directly in market prices."[18]

Externalities are rampant in electric transmission systems[19] because whenever power is placed on the grid, it impacts other transmission users in several ways. First, transmission lines have finite capacities. When a line's maximum capacity is approached (i.e. it is congested), one transmission customer's use of the line may prevent another from being able to send power across it. Second, because power flows along the path of least impedance, sending power across "one line" (i.e. a contract path) may significantly change

[16] FERC, April 1995.
[17] FERC, December 1995.
[18] Pindyck and Rubinfeld, 1992, 604.
[19] Stalon, 19 October 1995.

the power balance on the contract path line and on other, electrically close lines. The result is that even if one contracts with transmission company A to send power across its lines, transmission company B is likely transmitting some of the power (without compensation) and being impacted by it (which creates externalities). The impacts on transmission line B can range from increased transmission line losses to out-of-order dispatch. Third, real power transmission line losses increase with the square of current passing through the line. Therefore, when a party sends power across a line, the power of other line users is dissipated at a higher rate.

While these externalities pose technical challenges in a vertically-integrated industry structure, they have been largely internalized in the bundled rates of utilities. However, as the grid is opened up to many, competing transmission customers, these externalities should be addressed in transmission pricing structures and operating protocols in order to ensure efficient operation of the system in the short-term, and to signal efficient long-term system planning.

9.2.1.4 Efficiency Issues

Based upon this discussion, electric transmission systems clearly do not meet the criteria for perfectly competitive markets. This finding is not unexpected, however, since transmission is generally considered to be a classic natural monopoly.[20] For transmission systems to operate in a relatively efficient manner following industry restructuring, several issues should be included in the criteria we put forward at the end of this chapter:

- Price signals should reflect marginal costs;
- Information on pricing and service quality should be made available to all transmission systems users in an open and non-discriminatory manner;
- Regulatory oversight of transmission systems should continue as long as they are deemed to be natural monopolies;
- Mechanisms for internalizing externalities through pricing systems and technical requirements should be developed;
- The public/collective goods of transmission systems should be identified, and incentives/structures should be developed to ensure their provision in a restructured industry; and
- The vertical market power of transmission utilities should be reduced, if not eliminated.

While our study of basic economic principles has yielded the identification of some issues that should be incorporated into our efficiency criteria, more issues should be identified. In order to do so, we examine several studies that have evaluated economic efficiency in the electric power industry.

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[20] Weiss, 1971, 144.

9.3 Electric Power Industry Economic Efficiency Studies

9.3.1 *Markets for Power*

In their 1983 book, *Markets for Power*,[21] MIT economists Paul Joskow and Richard Schmalensee use economic efficiency as their primary criterion for evaluating a set of industry restructuring proposals. Because of the difficulties in constructing an evaluation framework for economic efficiency, they employ qualitative, rather than quantitative "measures." Their analysis is based upon answering two broad questions: [22]

- Is electricity being supplied today, and will it likely be supplied in the future, at the minimum possible cost?
- Do the prices charged consumers of electricity appropriately reflect the costs of electricity supply, so that consumer decisions about electricity use also reflect those costs appropriately?

From the principles inherent in these question, Joskow and Schmalensee develop a more comprehensive analytical framework, which consists of four sets of issues, and subsets of criteria (in the form of questions) in each.[23]

9.3.1.1 Short-Run Production Efficiency Considerations[24]

- Are the current assets being used as efficiently as possible?
- Are there alternative institutional arrangements that are likely to improve the efficiency with which plant and equipment are used?
- Specifically, is the system using least-cost supply?
  - economic plant dispatch
  - efficient maintenance
  - minimum fuel procurement
  - efficient utilization of labor

9.3.1.2 Long-Run Production Efficiency Considerations[25]

- Investment decisions (in generation, transmission, distribution) should provide for least-cost production given the expected technology and input prices over the lifetime of the facilities. This includes:
  - appropriate mix of base-load, cycling, and peaking capacity (at least cost);
  - planning and coordination that occurs on a level of aggregation that can take advantage of maximum economies of scale;
  - transmission and ties between generation facilities operate at least cost (at any given point in time) and maximize system stability and reliability;
  - minimum cost construction of new facilities; and
  - realization of short-run efficiencies upon construction.
- What will be the effect of institutional arrangements and proposed alternatives on the rate of technological change?

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[21] Joskow and Schmalensee, 1983

[22] Ibid., 9.

[23] They also take into account several other considerations, including the cost of regulation and transaction costs. See Appendix J.8 for more on transaction costs.

[24] Joskow and Schmalensee, 1983, 82-85.

[25] Ibid., 85-88.

9.3.1.3 Short-Run Pricing Efficiency Considerations[26]

- Prices provide correct signals to buyers if and only if they are equal to marginal cost. Ideally, one would set the marginal cost instantaneously, however, transaction costs may make this inefficient.
- Long-term contracts may be desirable in the presence of uncertainty, imperfect information, incomplete insurance, and the possibility of opportunistic behavior.
- Prices should reflect marginal costs, taking appropriate account for metering costs and contractual complexities (these can include: spot pricing, non-linear rates, time of season rates, and time of day rates).
- Short-run consumption is mainly a function of current appliance stock (marginal cost pricing will not impact consumption much in the short-term).

9.3.1.4 Long-Run Pricing Efficiency Considerations[27]

- New (consumer) capital purchases will allow for increased efficiency gains (vis-à-vis short-run) due to marginal cost pricing.

9.3.1.5 Discussion of Framework

Joskow and Schmalensee's framework was effective for performing their analysis in 1983, and many helpful insights can still be gained from it today. As a result, many of the issues it raises are included in the set of criteria we establish at the end of this chapter. However, we do not employ it lock, stock and barrel because:

- It was designed to evaluate the entire industry, rather than focusing on transmission;
- It was designed to evaluate an industry that has changed significantly in the past 13 years (as has the political climate); and
- It places equal weight on short- and long-term issues while we focus on the latter.

Therefore, we examine several other industry studies to see how they handle economic efficiency.

9.3.2 <u>*Some Economic Principles for Pricing Wheeled Power*</u>

Several years later, Kevin Kelly, J. Stephen Henderson and Peter A. Nagler of the National Regulatory Research Institute wrote *Some Economic Principles for Pricing Wheeled Power.*[28] The report established seven "insights about pricing" which would promote economic efficiency in power wheeling:[29]

- Good decisions are those that result in incremental benefits to all parties greater than the incremental costs for all parties.
- There is no single best pricing rule for power exchanges or for wheeling that results in good decision-making. A variety of pricing rules can do so; these rules differ according to how the gains from trade are shared among the parties.

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[26] Ibid., 80-82.
[27] Ibid., 82.
[28] Kelly *et al*, 1987.
[29] Ibid., 150-151.

- All pricing rules that promote good decision-making produce the result that marginal generation supply costs of any pair of companies differ at most by the marginal cost of transferring power between them. We call this result the equalization of marginal costs across the grid.
- Marginal transmission cost between any buyer-seller pair in a network with parallel flow paths is determined on the basis of the weighted average cost per unit of energy over all paths linking the pair, where these costs are weighted by the fraction of the energy flow along each path.
- Either a series of direct two-party sales, a series of multi-party wheeling transactions, or a combination of approaches is capable of achieving the efficient result, the equalization of marginal costs across the grid. From the viewpoint of good decision-making, there is no single best organization of the industry: ... if power is priced efficiently and wheeling is priced efficiently, then (absent non-price impediments to power transfers and absent significantly different transaction costs with different ways of organizing the industry) the power flows that result are the same as those achieved by economic dispatch of the entire network.
- One may decide on the basis of fairness among pricing rules that promote good decisions, but starting with a fairness criterion may result in a rule that causes bad decisions to be made.
- Pricing for good decision-making requires that those who experience loop flow costs and who can affect decisions about the use and expansion of the transmission network be compensated at least for the incremental costs experienced between any buyer-seller pair.

These insights were developed from two closely-related fundamental principles: marginal cost equalization across the grid in the short-run and in the long-run. The latter principle is achieved when the grid is optimally configured such that transmission capacity is fully and optimally utilized at the planned peak-load level. The former occurs when the spatial marginal cost of electricity at any point on the grid is equalized (which takes into account marginal line losses and generating costs).[30]

9.3.3 Electricity Transmission: Realities, Theory, and Policy Alternatives

In 1989, a FERC-commissioned Transmission Task Force wrote *Electricity Transmission: Realities, Theory, and Policy Alternatives.*[31] This report features thorough discussions of important issues and policy alternatives with respect to transmission. While helpful as background -- basic concepts and policy options from it are used throughout this thesis -- the relevance of the report's analytical framework to this thesis is limited because:

- It is based upon assumptions of the pre-Energy Policy Act of 1992 (EPAct) era;
- Economic efficiency is only one of several issues in the framework's issue matrix;[32] and
- Its criteria are rather prescriptive in nature.

Nevertheless, we draw on this report extensively later in this chapter when we discuss pricing efficiency.

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[30] Ibid., 247-248.
[31] FERC, 1989.
[32] Ibid., 148.

9.4 TECHNOLOGICAL CHANGE AND EFFICIENCY

Joskow and Schmalensee's framework identifies technological change as being important to long-run production efficiency.[33] In this section, we attempt to answer the question, why is technological change important?, at both the societal and industry levels; and then examine some economic research and experiences within the industry with the purpose of identifying further issues to include in our efficiency criteria.

9.4.1 Importance to Societies

Technological change on the societal level plays a central role in increasing real incomes[34] and serves as an important determinant of economic growth --- "technology is the engine of economic growth,"[35] its "prime mover."[36] In a pioneering study, MIT economist Robert Solow estimated that during the period 1909 to 1949, when the gross output of an American worker doubled, 87 1/2 percent of the productivity increase was due to technical change.[37] Since Solow's findings were published, economists have paid a significant amount of attention to the topic of technological change and economic growth.

9.4.2 Technological Change Within the Industry

9.4.2.1 Technological Change's Impact Through the Industry's History

The impact of technological change on the electric power industry has been profound. In many ways, the growth of the industry has been driven by improved technologies in both generation and transmission. In its early years, the electric power industry was composed of many small generators, located close to the loads they supplied. Utilities began to serve larger regions as advances in transmission technologies allowed for increasing transmission voltages,[38] which allowed for increased transmission distances. This was done, in part, to take advantage of increasing economies of scale made possible by advances in generation technologies. Incremental improvements to the thermal-steam generating plant (which operates on the thermodynamic Rankine Cycle) allowed for higher energy conversion efficiencies and increasing economies of scale. The technological improvements in the industry over the past century have been matched by few industries. For example, between 1899 and 1953, the total factor productivity of the industry rose at an average annual rate of

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[33] Ibid., 85.
[34] Joskow and Rose, 1989, 1483.
[35] Clinton and Gore, 1993, 7.
[36] David, 1986, 373.
[37] Solow, 1957, 320.
[38] Kelly *et al*, 1987, 281-284.

5.5%.[39] (See Table 9.1 for a comparison to other industries.) In another quantitative study, this one of scale economies in the electric power industry, Christensen and Greene found that while scale economies played a part in the decline in real electricity prices between 1955 and 1970, technological improvement was a far more important contributor.[40] However, when the thermodynamic limits of the Rankine Cycle were reached in the 1960s[41] and the supercritical generation technologies that were subsequently employed were not as reliable as their smaller, less advanced brethren,[42] the industry became fertile ground for the introduction of new generating technologies. From the technology standpoint, these factors led to the sea-change in the industry that we see today.[43]

Table 9.1: Total Factor Productivity Gains in Selected Industries

Industry	Average Annual Total Factor Productivity Increase (%), 1899-1953
Electric Power	5.5
Manufactured Gas	4.7
Chemicals	2.9
Fabricated Metals	2.6
Railroads	2.6
Electric Machinery	2.2
Natural Gas	2.0
Telephone	2.0
Machinery, non-electric	1.7
Farming	1.1

Source: Kendrick, 1961, 136-137.

As the industry moves toward deregulation, many of the institutional changes that are now occurring would not have been possible without continuing technological advance.[44] For example, advanced aeroderivative and combined-cycle turbine technologies have low operating costs and per production unit capital costs that are as little as one-quarter those of a large coal plant.[45] Furthermore, the construction lead times on advanced gas turbine generators are as little as one year. This is in sharp contrast to the situation only one decade ago. In 1985, Paul Joskow and Nancy Rose stated, "we recognize explicitly that power plants are not standardized piece of equipment manufactured in factories, but are brought

[39] Kendrick, 1961, 137.
[40] Christensen and Greene, 1976.
[41] Yeager, 1994.
[42] Joskow and Rose, 1985.
[43] Yeager, 1994, 27.
[44] Yeager, 1995, 50.
[45] Bayless, 1994, 21.

into operation as a consequence of large-scale construction projects."[46] In addition to the changes facilitated by new generation technologies are improvements in information technologies (IT). In particular, advances in microprocessor technologies are increasing information-processing capabilities while decreasing costs. These improvements allow for metering and system control activities that were previously technically or economically infeasible. In looking to the future, the industry's growth trajectory will likely be determined by the industry's effectiveness in harnessing technological advance.[47]

9.4.2.2 Industry Structure and Innovation

Technological improvements occur within the context of an industry's organizational structure. As William Hughes comments, "The evidence ... suggests that both technical efficiency and technological progress have been closely tied to the organization of the industry."[48] Changing organizational contexts have helped to drive the technological improvements of the 1980s and 1990s. For example, while NUGs were not responsible for the basic development work that went into advanced gas turbine generators, their adoption of the technologies served as an important demand stimulus. As Paul Joskow notes, "QF developers provided a major stimulus to advances in CCGT technology and have been successful in applying this technology very efficiently."[49]

9.4.2.3 Efficiency Issues Regarding Technological Change

From this discussion we make several findings about the importance of technological innovation in the electric power industry and its implications for industry structure. First, technological change makes an industry more efficient. Second, since industry structure impacts technological advance, the restructuring proposals should be designed to facilitate technological change and to reduce impediments to innovation. Third, because technological innovations can lead to changes in industry structure, the industry should be restructured in a manner that would allow it to adapt to innovations in a relatively efficient manner.

9.5 TECHNOLOGICAL CHANGE FACILITATION AND IMPEDIMENTS

These findings prompt two interrelated questions, how can technological innovation be facilitated, and conversely, what are impediments to it? We attempt to answer these

[46] Joskow and Rose, 1985, 2.
[47] Yeager, 1995, 59.
[48] Hughes, 1971, 46.
[49] Joskow, 1994, 20.

questions concurrently, by examining the results of economic research and experiences within the industry. We start with a discussion of why it is important to make explicit considerations for technological change.

9.5.1 Increasing Returns (Positive Feedbacks) and Technological "Lock-In"

Classical economics assumes that the market's invisible hand guides technological development and market structures to the most efficient outcome. However, recent economics research indicates that this is not necessarily true, especially in markets with characteristics similar to a transmission system, which has been described as "the largest interconnected system man has invented."[50] W. Brian Arthur posits that technologies which:

- are produced through knowledge-based processes,
- have high fixed and low marginal production costs, or
- are used in networks that require compatibility,

tend to have *increasing returns* characteristics (also known as positive feedbacks).[51] Transmission systems likely have increasing returns characteristics as a result of their network properties, and to a lesser extent, their significant sunk costs. When an industry has increasing returns characteristics, technological "lock-in" (i.e. the technology or product that takes a lead in adoption tends to stay ahead and increase its lead) can occur. Arthur, in fact, posits that an increasing returns system will converge to dominance by one technology with a probability of one. Nathan Rosenberg reaches a similar lock-in conclusion in his evaluation of the telecommunications industry. Lock-in occurs because "future investments must remain compatible with the currently chosen system, as capital in telecommunications is usually long-lived."[52]

The efficiency implication of this research is that transmission systems could readily become locked-in to "inferior" technologies which would essentially prohibit the use of more efficient technologies that might currently exist, or be developed in the future. (The most cited example of an inferior technology being adopted is the near-universal adoption of the QWERTY keyboard on typewriters.)[53] The challenge that results is to prevent lock-in to inferior technologies. According to increasing return economics, however, this is more difficult than it sounds, because "small chance events early in the history of an

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[50] Schweppe, 1978, 42.
[51] See: Arthur, 1990; Arthur, 1989. For a less technical discussion of this, see: "The Theory That Made Microsoft."
[52] Rosenberg, 1994, 205.
[53] See, for instance: David, 1985. According to the theory, a similar situation could have happened in the electric power industry. See Appendix J.4 for a more thorough discussion.

industry or technology can tilt the competitive balance."[54] This "chance" element may be reduced in the case of electric power transmission, however, since "lock-in" to the current transmission technologies has already occurred. Thus, it would likely take some significantly "better" (presumably more efficient) technology to replace what is currently "locked in." With this being the case, the significant lesson from this discussion is that efficient technological change in transmission systems is not predetermined.

9.5.2 Impact of Market Structure on Technological Adoption

Some economists have concluded that "changes in industry structure ... do affect the incentives for developing specific technologies."[55] In light of the previous discussion and the significant changes that the restructuring proposals promise, it would be valuable to examine what these impacts are.

9.5.2.1 Incumbent Firms

Some research suggests that the innovativeness of an industry's "established" firms tends to athropy. For example, in a study of fifty innovations that led to new technological paradigms in their respective industries, Burton Klein found "no case in which the advance in question came from a major firm in the industry."[56] In a similar vein, a recent *Harvard Business Review* article concluded that "every company that has tried to manage mainstream and disruptive[57] businesses within a single organization failed."[58] These (and other similar) findings would suggest that allowing new, competitive entrants into at least some transmission functions would increase innovation in transmission technologies.[59]

9.5.2.2 Monopolies And Competition

From both theory and practice it has been observed that technological innovation appears to be retarded in the presence of monopolies and to increase when competition enters an industry.

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[54] Arthur, 1990, 92.
[55] Greenwald, 339.
[56] Klein, 1977, 17.
[57] "Disruptive technologies introduce a very different package of attributes form the one mainstream customers historically value." Source: Bower and Christensen, 1995, 45.
[58] Bower and Christensen, 1995, 51.
[59] A potential contradiction to this finding is that technological advances in the electric power industry have traditionally been made by the equipment manufacturers rather than the utilities. Thus,

9.5.2.2.1 X-Efficiency Theory

In his X-efficiency theory, Harvey Leibenstein claims that the largest efficiency loss caused by monopolies is not the result of their ability to artificially constrain supply and raise prices; but rather, that monopoly firms do not operate on the outer bound of their production-possibilities curve.[60] One of several contributors to this "X-inefficiency" is a failure to innovate.[61]

9.5.2.2.2 Incentives of Rate of Return Regulation in 1970s

Some economists and environmental advocates criticized utilities during the 1970s for being slow to adopt new generation technologies, especially "environmentally friendly" ones such as renewables and cogeneration. In fact, PURPA's small power production provisions were, at least in part, the result of frustration on the part of Congress and the Carter Administration with this recalcitrance by utilities.[62]

9.5.2.2.3 Averach-Johnson Effect

Some argue that one reason for the utilities' recalcitrance was that rate-of-return (ROR) regulation provided incentives for constructing coal and nuclear plants (instead of smaller, alternative energy ones). Theoretical grounding for this argument came from Averach and Johnson, who theorized that a firm operating in a rate-of-return regulatory environment faces incentives that lead to two types of socially inefficient behavior:[63]

- The firm does not equate marginal rates of factor substitution to the ratio of factor costs; therefore a firm operates inefficiently in the sense that (social) cost is not minimized at the output it selects.
- The firm has an incentive to expand into other regulated markets, even if it operates at a (long-run) loss in these markets; therefore it may drive out other firms, or discourage their entry into these markets, even though the competing firms may be lower-cost producers.

Although Averach and Johnson focused on telecommunications in their analysis, the Effect is intended to describe the behavior of all rate-of-return utilities. When its first finding is applied to the electric utility industry, the Averach-Johnson Effect implies that ROR regulation rewards utilities for large capital expenditures (such as building coal and nuclear plants). The implication is that continued ROR regulation of transmission might impede the adoption of less capital-intense new transmission technologies. It should be noted,

60 Leibenstein, 1966. Such effects are seen as one of the primary sources of expected efficiency improvement in the restructured electric power industry. See, for example: Tabors Caramanis & Associates, 1995, 47.

61 Leibenstein, 1966, 398.

62 Dasovich *et al*, 1993, 50.

63 Averach and Johnson, 1962, 1052. These findings are commonly referred to as the Averach-Johnson Effect.

however, that the Effect's validity, like many economic theories, is not universally accepted.[64]

9.5.2.2.4 Experiences of Deregulation in Other Industries

A widely accepted observation from the deregulation experiences of other industries is that the emergence of new competitors in markets previously dominated by monopolies stimulates technological advance.[65] Explanations for this include:

- Firms in a deregulated market are forced to be more innovative in order to gain or maintain competitive advantage;
- New firms bring with them new organizational structures that stimulate innovation;
- The increased number of firms create a larger number of potential customers for innovative suppliers and creates incentives for new firms to enter the supply business; and
- The profit caps on regulated utilities provide insufficient incentives for adopting new technologies which might improve.[66]

9.5.2.2.5 Firms With Special R&D Capabilities

The commonly cited counter-example to the above observation is the decline of several exceptional laboratories affiliated with companies that had either legal or *de facto* monopolies.[67] The most commonly cited ones are AT&T (Bell Labs), IBM (Watson Labs), RCA (Sarnoff Labs), and Xerox (Palo Alto Research Center). As Vietor observes,

> In basic science and engineering, Bell Laboratories was an extraordinary innovator. Only the protected earnings produced by AT&T's regulated monopoly made such a research effort possible.[68]

The common experience of these labs has been that they developed remarkable innovations over the past five decades, but have faced significant cut-backs as their parent companies encountered competition (or stiffer competition).[69] A similar experience is now occurring in the electric power industry -- major electric utility R&D budgets dropped by one-third in 1993 alone, with utilities in states at the vanguard of the competition movement making the largest cuts.[70]

However, the negative consequences of this phenomenon are not likely to be significant in the electric power industry for two reasons. First, the four cited examples were

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[64] For a review of the various studies and an evaluation of their findings, see: Joskow and Rose, 1989, 1477-1480.

[65] For example, see: Knight, 1995; Gardner and Gilson, 1994; and Bradford, 1994, 8.

[66] This is a suggestion of the author, based upon: Lyon and Huang, 1995, 772.

[67] For more discussion of this, see Appendix J.5.3.

[68] Vietor, 1994, 319.

[69] Sarnoff labs, in fact, was given away to a private firm when General Electric purchased RCA in 1987. Source: Dertouzos *et al*, 1989, 227.

[70] "High Noon for R&D," 60.

exceptionally innovative labs, matched by few, if any other industrial facilities. Beyond the upper echelon which includes these four and perhaps several others, there is little evidence that large industrial R&D facilities have advantages over smaller ones.[71] Secondly, most of the technological advances in the electric power industry have been made by electric power equipment manufacturers, rather than utilities.[72]

9.5.2.3 Efficiency Issue

The significant finding of the discussion so far is that competition, in at least some aspects of transmission, would likely have a positive impact on technological innovation.

9.5.2.4 Scope of Regulatory Bodies[73]

A lesson on the relationship between the geographic scope of regulatory bodies and technological innovation can be learned by contrasting the relatively advanced Chicago electric power system prior to World War I with London's relatively backward system.

9.5.2.4.1 Chicago

Between 1890 and 1905, as many as 47 franchises were granted to provide electricity to part or all of Chicago.[74] Because of a combination of engineering and economic skills, Samuel Insull recognized that a consolidation of these many small (often competing) electricity companies would increase efficiency. He also understood the political actions necessary to form a consolidated system. After outmaneuvering a group of local cronies, he was able to purchase a 50-year service franchise for all of Chicago. However, due to the increasing scale economies provided by new technologies and observations on the experiences of other "utility" industries in the corrupt Chicago political environment, Insull concluded that state (rather than municipal) regulation would better promote the continued expansion and improvement of electric power systems. After years of advocating state regulation, he persuaded the National Electric Light Association (NELA) to support the concept in 1907. Three states established regulatory agencies that year, and 33 states had such bodies by 1916.[75] With regulatory authority in the hands of the states, electric companies were free to grow beyond city boundaries in order to take advantage of economies of scale, and were exempt from the fragmentation and potential corruption of municipal regulators.

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[71] Acs and Audretsch, 1991, 55.
[72] Mowery, 1983, 35; and Joskow and Schmalensee, 1983, 87.
[73] For a fuller account of the details in this section, see: Appendix J.6.1 or Hughes, 1983, 201-261.
[74] Wilcox, 1910, 143.
[75] Hyman, 1988, 68.

9.5.2.4.2 London

In contrast, the governing structure of London was Balkanized -- electric companies had to contend with at least three levels of local government, with forces at the lowest level being least amenable to the creation of a consolidated system (i.e. each borough government adamantly maintained control over its area). As a result, within the domain of the London city council, there were 28 boroughs and twenty-eight utilities,[76] and in the Greater London area there were 65 utilities. These political and industry structures had a deleterious effect on the development of new technology, which is best evidenced by the failure of the Deptford power station. Despite being "considered as the forerunner of all modern central power-stations,"[77] the plant failed due to a lack of financial support from its investors (which resulted from the balkanized London governance structure preventing it from taking advantage of scale economies). When the plant failed, so too did Britain's attempt to stay at the technological frontier in electric power systems. Between the late 1880s and early 1910s, London went from being one of the world's most advanced cities (in terms of electrification) to being one of the laggards, in large part due to its Balkanized governance of the industry.

9.5.2.4.3 Efficiency Issue

The most significant lesson from these contrasting stories is that in order for a system to operate efficiently and take advantage of technological opportunities, the bodies that regulate it should be composed in a manner that allows them to regulate with a system-wide perspective.

9.5.2.5 Unnecessary Foreclosure of Technologies

Another example of a government-created impediment to technological innovation in the industry was a sister bill of the Public Utility Regulatory Policies Act of 1978 (PURPA) -- the Powerplant and Industrial Fuel Use Act of 1978 (PIFUA). As mentioned previously, PURPA and its sister Acts were intended to wean the nation from foreign petroleum dependence.[78] PIFUA was the most blunt instrument in this strategy, and was especially harsh on gas-fired power generation;

> Natural gas or petroleum shall not be used as a primary energy source in any new electric powerplant; and no electric powerplant may be constructed without the capability to use coal or any other alternative fuel as a primary energy source.[79]

[76] Hughes, 1983, 236.
[77] Singer *et al*, 1958, Vol. V, 200.
[78] See Sections 3.3 and 3.4.
[79] *PL95-617*, 3298.

The law further stated, "natural gas shall not be used as a primary energy source in an existing powerplant on or after January 1, 1990."[80] Exceptions to both provisions were available by statute (such as the use of gas for fueling cogeneration plants) and at the discretion of the Secretary of Energy. Although the end of the energy crisis led to broad use of the latter exception,[81] utilities faced significant disincentives to adopt the new, revolutionary gas turbine generators until the Act was repealed in 1987 because their investments could immediately be rendered useless if the law were "re-enforced."[82]

The most significant lesson from the PIFUA case is that caution should be taken before the long-term use of a particular technology is foreclosed. By only looking at a technology's current state of development, one can overlook the potential for technological development as well as changes in the status of alternative technologies. That is not to say that regulatory oversight should be abdicated, however, since there may be legitimate public policy or safety issues at stake that are of a higher value than efficiency. But policy decisions as drastic as PIFUA should only be made after carefully considering future technological possibilities.

9.6 EFFICIENT PRICE SIGNALS

9.6.1 The Coming Shift From Completely Centralized to Partially Market-Based Transmission Planning and Operation Decision-Making

Currently, utilities are the suppliers of bundled transmission service. They build and operate transmission wires and associated equipment, are responsible for system control and the ancillary services, and plan future transmission system improvements. While utilities perform many of the short-term tasks individually, they make transmission planning decisions in conjunction with other utilities (especially with those in the same North American Electric Reliability Council (NERC) region) and with input from a variety of government organizations. In a restructured industry, the role that utilities will play in transmission planning is certain to change. For example, because of the intimate relationship between transmission and generation, centralized transmission planning includes generation site selection. But, as deregulation gives non-utility generators (NUGs) more autonomy and NUGs become a larger force in the industry, centralized planning of generation siting will likely cease. Furthermore, as utilities begin to compete with each other, the gentlemanly planning agreements (through NERC's reliability

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[80] Ibid., 3305.
[81] Pierce, 1988, 11.
[82] Budhraja, 1995 33.

councils) that have been forged between "cooperative" firms will likely become strained, and perhaps eventually break.

Transmission system "real-time" control may also be removed from the domain of integrated utilities since many people believe that a truly fair, competitive generation market cannot emerge as long as transmission systems are operated by vertically-integrated utilities.[83] Although the Mega-NOPR would not mandate independent system operators (ISOs), numerous state proposals call for their creation and several groups of utilities are proposing the voluntary formation of ISOs.[84]

If utilities lose internal control over transmission operation and planning, it would be necessary to replicate at least some of these centralized functions with market mechanisms -- specifically price signals -- in order for the grid to be planned and operated efficiently. The shift in the locus (from central planning to the market) of some of these responsibilities would be consistent with trends in the rest of the industry, although creating "proper" pricing incentives would be a complicated undertaking.

9.6.2 Efficient Pricing as the Key to Increasing Efficiency in a Restructured Industry

9.6.2.1 General Discussion

The primary mechanism by which deregulation is expected to promote efficiency in the electric power industry is that bundled prices which make costs opaque to consumers would be replaced with unbundled prices which would make costs transparent. The expectation is that efficient prices would signal efficient behavior by producers, consumers, and intermediaries. Thus, the restructured industry will only be as efficient as the pricing structure that is adopted (and the signals it sends).

It is expected that generation price signals will be set through the market process of matching of supply and demand, while regulated transmission prices will be set by bureaucratic decisions. In this context, the pricing decisions of regulators would be extremely important determinants of economic efficiency in transmission. Because the fixed costs of transmission are substantially higher than the variable operating costs,[85] and because both the fixed and variable costs are difficult to attribute to individual grid users,

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[83] Stalon, 1995.
[84] In addition to ISOs mentioned in previous chapters, see: "Texas Moves to Open Access, ISO and Unbundled Services;" and "Giant ISO Set for Midwest."
[85] There are essentially three types of transmission service costs: capacity, marginal losses, and congestion. Source: Shuttleworth, 1994, 28.

transmission prices are particularly difficult to set. As Peter Temin has stated, "there is no uniquely correct way to allocate fixed costs to units of production. There is also no uniquely correct way to allocate joint costs to disparate activities."[86] Therefore, transmission prices must be set through a regulatory process where there is no "correct" way to allocate costs, yet, as we see above, they should be set in a manner that signals efficient system use.

9.6.2.2 System-Wide Efficiency Considerations

A fundamental principle of economically efficient transmission pricing is that the difference between the marginal cost of generating electricity at any two locations should equal the marginal cost of transmitting electricity between them.[87] When this principle is not met, it would be more efficient to produce power in another configuration of generation and load. For example, if the cost of transmission is greater than the price difference between two generators, the generator on the side of the transmission line to where power is being "imported" should produce additional power (rather than have it transmitted from the other generator). If the transmission price is lower than the difference in generation marginal costs, the less-expensive plant should produce more power (and the more expensive one should curtail production commensurately). While most easily applied for short-run decision-making, this basic concept is also vital in signaling efficient system planning and behavior by transmission "customers" and "suppliers" with respect to long-run marginal costs.

9.6.2.3 Transmission "Customers"

The "customers" of future transmission systems will include generators, distribution companies, aggregators, and large industrial customers.[88] In order for the grid to operate efficiently in both the short- and long-run, these "customers" will need to receive efficient price signals.

In the short-run, efficient prices would signal efficient utilization of transmission systems by their customers (and would include considerations for congestion and externalities). If transmission is priced super-economically, competition in the generation market would be

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[86] Temin, 1994, 11. Also, Kelly et al's framework mentions that several pricing mechanisms might work. see: Kelly *et al*, 1987, 150.
[87] FERC, 1989, 86; and Kelly *et al*, 1987,
[88] Retail wheeling might also lead to individual customers being added to this list. Also, note that these entities do not match those who are considered "customers" in usual discussions of the electric power industry, as such discussions usually focus on power delivery.

retarded. Similarly, artificially low transmission pricing would promote inefficient use of transmission systems.[89] For example, if prices are too low,

> Entities may contract for firm capacity and then hold the capacity without using it. This 'hoarding' of transmission capacity would be motivated by an opportunity to resell it at a profit, to create a constraint in the transmission system, or otherwise to manipulate the market.[90]

In the long-term, efficient pricing would signal efficient construction of generation, load, and transmission facilities (i.e. it would signal the construction of facilities that equalize marginal costs across the grid). As William Hogan comments, "the long-run market is the key to overall efficiency. The most important requirement [in developing pricing mechanisms] is to provide the right incentives for location and construction of generating facilities and new load centers."[91] If transmission prices were too high over the long-run, otherwise efficient power trades would not occur because the generating capacity necessary to facilitate them would not be built. In addition, an incentive to "over-build" transmission capacity would exist. Conversely, if long-run prices were too low, generators would not be sited in a technically efficient manner and there would be inadequate incentives for efficient transmission facility maintenance and expansion. Because of the high capital costs and long-lived nature of generation and transmission facilities, inefficient construction decisions would have expensive, long-term consequences.

Therefore, in order for transmission systems to be constructed and utilized optimally (or in a manner that approaches it), prices must send proper signals to transmission suppliers and customers that encourage efficient location of new generators (and new customers)[92] as well as efficient operational use of those facilities.

9.6.2.4 Incentives for Transmission "Suppliers"

As mentioned above, efficient price signals should promote the construction of transmission capacity in appropriate quantities and locations and at appropriate times. In short-run marginal cost-based pricing schemes, revenues to signal and pay for new transmission capacity would be provided by congestion charges.[93] However, without appropriate provisions to ensure that collected congestion revenues finance construction, congestion charges could create an incentive to constrain transmission capacity.[94]

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[89] Kuhn, 1995, 24.
[90] Dairyland, 1995, 5.
[91] Hogan, 1992, 214.
[92] Shuttleworth, 1994, 30.
[93] Ibid.; FERC, 1989, 94; and Kelly *et al*, 1987, 182.
[94] See, for example, Hogan, 1992. There is not consensus on the best mechanism for accomplishing this, however. In the past year there has been a heated debate on the subject.

The industry currently appears to be experiencing what happens when there are insufficient incentives for capacity expansion. In the past several years, capacity expansion has fallen precipitously -- today it is one-half of what it was 2-3 years ago.[95] The cause of this significant drop appears to be uncertainty regarding the recovery of transmission investments during and after the transition to a restructured industry. Thus, economic theory and recent industry experience suggest that the development of efficient pricing mechanisms, with sufficient incentives for capacity expansion, is important for ensuring that the grid is expanded efficiently.[96]

To summarize, in order for the system to be operated efficiently in both the short- and long-run, it is imperative that efficient price signals be sent. This is a radical departure from past and current transmission pricing practice, where embedded cost rates, command and control regulation, internalized utility decisions, and utility cooperation have guided system use and planning. Let us now briefly examine several issues regarding transmission pricing mechanisms for a restructured industry.

9.6.3 Discussion Of Pricing Issues

9.6.3.1 Variable Pricing

Electricity prices have traditionally been time invariant -- pre-determined (based upon historical average service and embedded costs) and constant from day-to-day (adjusted at intervals on the order of years), regardless of the demand or production costs at any given time. Similar pricing mechanisms have been used for electric transmission wholesale wheeling rates[97] (the rates that utilities charge non-native load customers to send power over their transmission lines). The traditional (and until recently exclusive) wheeling rate structure has been "postage stamp" rates -- which are "fixed rate[s] per kilowatt hour for using a utility's transmission system."[98] The problem with postage stamp rates is that they do not promote efficient decision-making because they neglect temporal and spatial cost differences.[99] Clearly, time-invariant rates do not promote efficient use of transmission (or generating) resources. In a previous chapter we discussed time-varying generation pricing -- spot pricing.[100] The development and use of analogous transmission pricing mechanisms (temporally and spatially variant) would promote efficient short- and long-run use of the grid.

[95] Masiello *et al.*, 1995; NERC, 1992, 18-19, and NERC, September 1995, 23.
[96] Corey, 1991, 15; Shuttleworth, 1994, 31.
[97] Kelly *et al*, 1987, 154.
[98] Ibid., 242.
[99] Ibid.
[100] See Section 2.4.5.

9.6.3.2 Marginal Cost Pricing

Despite widespread agreement among economists that marginal cost-based prices send the most efficient price signals, there is a heated debate over the specifics of transmission service pricing structures. In particular, the question of whether short-run or long-run marginal cost pricing is a more appropriate mechanism for transmission service pricing has long divided economists. Because it is not the purpose of this thesis to resolve the debate, we do not discuss it any further here (although more details are provided in Appendix J.10), but we do conclude that efficient pricing occurs when transmission customers see prices that reflect marginal costs.

9.6.3.3 Other Pricing Considerations

Elsewhere in this thesis we discuss several "special" physical characteristics of electric power systems.[101] Some of these also lead to economic complications because the physical characteristics are associated with the creation of externalities or public/collective goods.

Two sources of economic externalities in transmission systems are loop flows and congestion. Their technical nature makes their economic costs difficult, yet necessary, to appropriate. Since this thesis' purpose is to provide criteria for evaluating proposals, not to develop pricing mechanisms, we limit our comments to saying that considerations for these externalities should be incorporated into transmission pricing structures.

Public/collective goods also pose challenges for developing pricing mechanisms. As is discussed in Appendix J.10, the development of an efficient generation market requires that the system controller have adequate resources at its disposal for providing system control and ancillary services. However, because of the collective goods nature of these activities, transmission customers do not have sufficient incentives to furnish these on their own. Therefore, transmission pricing structures should include mechanisms that sufficiently fund and efficiently appropriate their costs.

9.6.3.4 Comments on Pricing Issues

Significant improvements in transmission pricing theory and the information technologies needed to implement them have occurred over the past decade. Nevertheless, all contemporary transmission pricing schemes have theoretical imperfections as well as technological and economic IT limitations. While "perfect" prices that provide no economic

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[101] See Section 2.4.3.

distortions would be ideal, some imperfections must be tolerated in the real world.[102] Continued technological and intellectual advance holds the promise for future pricing mechanism refinements that could better capture the true costs of system use; and in turn, monitor and appropriate them in a more economic manner. While these advances are not certain, realizing their potential and laying the intellectual groundwork and policy flexibility now would help facilitate them if they occur. As a result, policy-makers should not create new structures that are inflexibly designed solely to meet today's capabilities. Nor should they decide to continue to employ the inferior, traditional pricing mechanisms in hopes that something better will come along someday. In short, functionality, rather than theoretical perfection, should be the goal in developing transmission pricing for the restructured industry.

9.6.4 Pricing Efficiency Issues

From out truncated discussion of pricing issues, we identify several issues that should be incorporated into our criteria. First, the ability for transmission suppliers and consumers to see proper price signals is essential for transmission systems to be efficiently constructed, maintained, and operated in a restructured industry. Hence, economic (pricing) incentives should be designed so that there is congruency between technical and economic efficiency and rational individual economic behavior.

Second, transmission prices should be established by marginal cost-based pricing mechanisms, whenever technically possible. The qualifying phrase is added because there are limitations in the ability to price at marginal cost which result from deficiencies in economic theory and in the technologies needed to send such signals.

Third, as a consequence of the above deficiencies, the regulatory framework should be designed so that it can evolve with experience in a deregulated system and improvements in IT and economic theory.

Fourth, transmission systems have several technical characteristics which have externalities or public goods implications that should be included in transmission pricing mechanisms.

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[102] Kelly *et al*, 1987, 24.

9.7 Efficiency Lessons From Previous Chapters

In Chapters 6-8 we examine the deregulation of the natural gas and telephone industries, potential new technologies in electric power transmission, and the efficiency implications of divestiture.[103] Here we recall the efficiency lessons from these chapters:

- Market structure should be robust to changes;
- Price setting matters;
- It is vital that customers have access to understandable information and price signals;
- Freedom for new market mechanisms to develop should be allowed;
- Transition costs should be equitably shared;
- In mixed regimes, regulation should match structure;
- There are some transmission technologies that are currently being developed that have the potential to make substantial changes in transmission systems;
- Market power can be a significant impediment to the emergence of a truly competitive market;
- Actions to mitigate market power should be based upon careful analysis of the potential for market power abuse and the efficiency costs of remediation; and
- Technologies that are currently being developed hold the potential for making significant changes in the industry's future structure (if they are allowed to develop).

9.8 The Framework

We now pull together the efficiency issues identified in this and the preceding three chapters and form the set of criteria that we use to evaluate proposals for industry restructuring. The criteria in our framework are intended to be cumulative in nature (i.e. an "ideal" proposal would meet each of them).

9.8.1 Transmission Pricing Criteria

- Prices provide correct signals if and only if they reflect marginal costs, taking appropriate account of transaction costs.
- Prices should make marginal costs transparent to all market participants.
- Prices should send spatially and temporally efficient signals for generation and transmission capacity construction and should take system considerations into account.
- Prices should signal technically and economically efficient short-run use of the grid by transmission "customers" and system operators.
- Pricing structures should retain sufficient flexibility to adjust to improved pricing theories or new technologies that would allow for more "accurate" cost distribution.
- Pricing structures should be robust with respect to future costs and demand.

[103] In Chapter 5 we also examined the experiences of other countries when they deregulated their electric power industry.

- Pricing structures that attempt to "protect" customer segment groups should be carefully constructed to avoid the creation of uneconomic incentives to bypass the transmission system.

9.8.2 Market Structure Criteria

- Transmission service functions should be provided competitively whenever possible.
- Transaction costs and re-integration through contract should be minimized.
- Information on pricing and service quality should be made available to all who use the system in an open and non-discriminatory manner.
- The public and collective good aspects of the transmission system should be identified and incentives/provisions should be developed to ensure that they will be provided in a restructured environment.
- The market structure should be as simple and understandable as possible, although simplicity should promote, not compromise, economic efficiency.

9.8.3 Regulatory Criteria

- The type and degree of regulation in each segment of the industry should be concomitant with its technical qualities.
- The regulatory authority over the transmission system should be composed in such a manner that it can regulate with a system-wide perspective.
- A dynamic and symbiotic relationship should exist between regulation and technological change which promotes the continued development of more efficient regulatory structures and technologies.
- Regulation should ensure that externalities are internalized in pricing systems and that technical requirements are developed in a manner that assures economically and technically efficient use of the system.

9.8.4 Transition Criteria

- Market participants, especially "bottleneck" participants, should be treated equitably in order to ensure a smooth transition.
- The potential for market power abuse should be carefully examined.
- Actions to mitigate market power should be based upon careful analysis of the potential for market power abuse and the efficiency costs of remediation.

9.8.5 Long-Term Transmission "Production" Criteria

- Pricing and regulatory incentives should promote cost minimization in the long-term of construction and operation of transmission facilities.

With a framework now developed, let us now apply it to the five restructuring proposals.

PART III:

ANALYSIS

Chapter 10
Evaluation of the Proposals

An opportunity to make efficiency improvements of the magnitude possible in electric industry restructuring comes along only once in a lifetime. We must not let petty doctrinal differences or narrow interest groups in pursuit of short term gains prevent the achievement of those improvements.[1]

-- Charles Stalon, paraphrasing Paul Joskow (1995)

10.1 INTRODUCTION

In the preceding chapters we discuss the technology and development of the electric power industry, outline proposals for its impending restructuring, and establish criteria for evaluating these proposals based upon their economic efficiency in transmission. In this chapter we tie together these efforts by applying our criteria to the proposals. We then synthesize and reflect upon our findings.

10.2 RESTATEMENT OF THE CRITERIA

Before we begin our analysis, let us restate our criteria, keeping in mind that they are intended to be cumulative in nature -- the "ideal" proposal would meet each of them.

10.2.1 Transmission Pricing Criteria

- Prices provide correct signals if and only if they reflect marginal costs, taking appropriate account of transaction costs.
- Prices should make marginal costs transparent to all market participants.
- Prices should send spatially and temporally efficient signals for generation and transmission capacity construction and should take system considerations into account .
- Prices should signal technically and economically efficient short-run use of the grid by transmission "customers" and system operators.
- Pricing structures should retain sufficient flexibility to adjust to improved pricing theories or new technologies that would allow for more "accurate" cost distribution.
- Pricing structures should be robust with respect to future costs and demand.

[1] Stalon, October 1995.

- Pricing structures that attempt to "protect" customer segment groups should be carefully constructed to avoid the creation of uneconomic incentives to bypass the transmission system.

10.2.2 Market Structure Criteria

- Transmission service functions should be provided competitively whenever possible.
- Transaction costs and re-integration through contract should be minimized.
- Information on pricing and service quality should be made available to all who use the system in an open and non-discriminatory manner.
- The public and collective good aspects of the transmission system should be identified and incentives/provisions should be developed to ensure that they will be provided in a restructured environment.
- The market structure should be as simple and understandable as possible, although simplicity should promote, not compromise, economic efficiency.

10.2.3 Regulatory Criteria

- The type and degree of regulation in each segment of the industry should be concomitant with its technical qualities.
- The regulatory authority over the transmission system should be composed in such a manner that it can regulate with a system-wide perspective.
- A dynamic and symbiotic relationship should exist between regulation and technological change which promotes the continued development of more efficient regulatory structures and technologies.
- Regulation should ensure that externalities are internalized in pricing systems and that technical requirements are developed in a manner that assures economically and technically efficient use of the system.

10.2.4 Transition Criteria

- Market participants, especially "bottleneck" participants, should be treated equitably in order to ensure a smooth transition.
- The potential for market power abuse should be carefully examined.
- Actions to mitigate market power should be based upon careful analysis of the potential for market power abuse and the efficiency costs of remediation.

10.2.5 Long-Term Transmission "Production" Criteria

- Pricing and regulatory incentives should promote cost minimization in the long-term of construction and operation of transmission facilities.

A "scorecard" of how each of proposals perform with respect to these criteria is found in Section 10.8 (see Table 10.2). With the criteria fresh in mind, let us commence with an evaluation of the California POOLCO proposal.

10.3 EVALUATION OF PROPOSAL I: CALIFORNIA POOLCO

10.3.1 Transmission Pricing Criteria

Let us begin by recalling several fundamental provisions of the California POOLCO[2] proposal. An Independent System Operator (ISO) would take responsibility for operating the system, while utilities would retain ownership of transmission facilities. The rates and service terms set by the ISO would be regulated by the Federal Energy Regulatory Commission (FERC).[3] Transmission owners would be able to enjoy a revenue stream from their assets only after operating experience confirms the ISO's independence.[4] Congestion pricing could be used to signal new transmission construction.

10.3.1.1 Transmission Pricing Criteria 1-7

POOLCO is difficult to evaluate using the transmission pricing criteria as it is relatively silent on the details of transmission pricing. One provision that appears to comply with our criteria is the possibility of signaling transmission construction by congestion pricing. A second point of intersection and compliance is found in the area of customer protection -- specifically the continuance of lifeline rates and low income ratepayer assistance. These programs would be funded through a non-bypassable fee, which should prevent perverse market bypass effects. A third point of compliance lies in the half-hourly or hourly spot market, which would inherently be robust to future prices and demand.

10.3.1.2 Transmission Pricing Criteria Summary

While POOLCO only touches upon and complies with three of our seven transmission pricing criteria, none of its provisions run counter to them. Hence, if further details would be developed, the proposal could meet most, if not all, of our pricing criteria. However,

[2]For the remainder of the chapter, the word "POOLCO" will be used to describe the California POOLCO proposal unless explicitly stated otherwise.
[3]Which, according to the FERC's interpretation of the Federal Power Act, is where the judicial system would rule that it belongs.
[4]CPUC, May 1995, 7.

such compliance is not guaranteed and the criteria that are not addressed are among the most significant of the seven.

10.3.2 Market Structure Criteria

10.3.2.1 Market Structure Criterion 1

Although it does not mention how, the proposal indicates that functional unbundling would allow for the competitive procurement (by the ISO) of ancillary services.[5]

10.3.2.2 Market Structure Criterion 2

Through its primary emphasis on a spot-market as the "market intermediary" between generation and distribution, POOLCO eliminates the problem of reintegration through contract and has relatively small transaction costs. Each market participant (i.e. generator, distribution company) would need to establish the capability, in terms of human resources and hardware, to trade in a spot market. However, the marginal cost of consummating any particular contract would be low and the spot market mechanism would eliminate the long-term costs of being locked into fixed contracts.[6]

10.3.2.3 Market Structure Criterion 3

While it does not specify exact transmission pricing mechanisms, the proposal assumes that the ISO would propose non-discriminatory pricing and service tariffs to the FERC that would be transparent to all market participants.

10.3.2.4 Market Structure Criterion 4

Other than the establishment of the ISO, for which a funding mechanism is not mentioned, POOLCO does not define, let alone provide funding mechanisms for the public and collective goods of the transmission system (i.e. the ancillary services which cannot be unbundled).

10.3.2.5 Market Structure Criterion 5

The overall industry structure would be relatively simple from the perspective of electricity customers. In fact, many customers would not notice much change from today's structure.[7] The trade-off for this simplicity is that, at least until bilateral trades were

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[5]CPUC, May 1995, 51.
[6]For more on contract theory, see: Appendix J.8.
[7]Those that engage in bilateral contracts, once they are permitted, would experience a much larger change. Furthermore, the change in market structure would become more pronounced once those who sell bilateral contracts begin to actively court customers.

permitted, there would not be an opportunity for innovative market structures to emerge (except in the development of contracts for differences). With regard to transmission specifically, it is difficult to know how "simple" POOLCO would be for customers (in this case generators, distribution companies, etc.) since transmission pricing details are not developed. The consolidation of operation of all utility transmission assets into one ISO is a step in the direction of simplicity, however.

10.3.3 Regulatory Criteria

10.3.3.1 Regulatory Criteria 1 & 2

POOLCO appears to match the technical characteristics of the industry with appropriate regulatory oversight. The proposal states that transmission retains its natural monopoly characteristics and concludes that regulatory authority over it should be vested in the FERC. Because the FERC would also be charged with regulatory oversight of the ISO's pricing and operation of the transmission system, the regulators (the FERC) should have a sufficiently broad perspective from which to regulate the transmission system. The proposal would extend performance-based regulation (PBR) to the distribution segment of the industry, which it asserts is a natural monopoly. The CPUC would essentially cease oversight (with regard to pricing and entry) of the generation segment, which it finds to be competitive.

10.3.3.2 Regulatory Criterion 3

It is unclear whether POOLCO would lead to a synergetic and dynamic, or a confining and static relationship between regulation and technological change. This lack of clarity is largely a result of the proposal's vagueness or complete deference to the FERC on most transmission regulation issues.

10.3.3.3 Regulatory Criterion 4

One of the significant benefits of an ISO, which the proposal alludes to in several different ways but does not explicitly address, is that it would allow for state-wide operation and pricing mechanisms. This would facilitate the development of a consistent pricing system that would internalize many of the transmission system's inherent externalities. Furthermore, since the system would be operated by a party without any beneficial interest in market participants and who would be required to economically dispatch generators on the system, the ISO should be free to promote the most technically and economically efficient use of the system.

10.3.4 Transition Criteria

10.3.4.1 Transition Criterion 1

The proposal attempts to treat "bottleneck" transition parties equitably through a competitive transition charge (CTC) that would provide utilities with full compensation for uneconomic power purchase contracts and regulatory obligations. It would also allow for 100% recovery of uneconomic generation assets.[8]

10.3.4.2 Transition Criteria 2 & 3

The proposal would make significant, if not complete, progress toward eliminating the market power of transmission owners by turning system operation over to a regulated ISO that is financially independent of other market players. POOLCO also considers the need to reduce market power in generation, but does not come to a decision on whether utilities should be required to divest their generating units, pending further review. The provisions regarding transmission and generation market power appear to prudently balance the potential costs and benefits of complete market power elimination.

10.3.5 Long-Term Transmission "Production" Criteria

Because the details of the incentives for constructing new transmission lines are not developed in the proposal, we cannot determine whether POOLCO would ensure that new facilities would be built in a cost-effective manner. The same can be said for the operation of the system, which would largely depend upon the regulatory mechanisms for oversight of the ISO and also upon the compensation scheme for the utilities who would continue to own, and possibly maintain the assets. One potential concern is that waiting too long to determine that the ISO is sufficiently independent of the utilities (during which period the utilities cannot receive a return on their assets) would lead to significant disincentives for the utilities to efficiently maintain their transmission facilities.

10.3.6 Other Analysis

From this discussion we conclude that POOLCO is on the right track with regard to creating an economically efficient transmission system. However, the proposal is far from complete, especially with respect to addressing important details that would have a substantial impact on the transmission system's long-term efficiency. While the basic structure appears to promote, or at least not constrain, economically efficient transmission in the long-term, pricing signals and regulatory incentives which are not outlined in it

[8]"Uneconomic" returns are defined as returns below an 8.5% rate-of-return on equity.

would play a major, if not overriding role in determining the efficiency of an industry based upon POOLCO.

Let us now perform the same analysis on the California Bilateral proposal.

10.4 EVALUATION OF PROPOSAL II: CALIFORNIA BILATERAL

10.4.1 Transmission Pricing Criteria

10.4.1.1 Transmission Pricing Criteria 1-7

The California Bilateral proposal[9] is essentially silent with regard to transmission pricing. One criterion that the proposal touches upon and meets is that of ensuring that consumer protection mechanisms do not produce perverse incentives to bypass the grid. The proposal explicitly indicates that cost recovery for public purpose programs, which include discounts to low-income customers, should not be part of the transmission or distribution fee, as "such a policy will produce unintended and undesirable consequences such as the construction of non-utility transmission lines outside of the Commission's jurisdiction."[10] The only other pricing criterion that is touched upon regards the price signaling of new transmission capacity. Although vague, the proposal indicates that the OPCO would be responsible for system planning and for managing congestion.[11] While it is difficult to make firm conclusions, the wording appears to indicate that planning processes and congestion policy implementation, rather than price signals, are the intended mechanisms for handling these issues.

10.4.1.2 Transmission Pricing Criteria Summary

While POOLCO provides precious little information with regard to transmission pricing, the Bilateral proposal provides even less. It is worrisome that not only are transmission pricing mechanisms absent from the document, but there is not even any mention of the issues involved. As a result, while we cannot conclude that the proposal would produce inefficient pricing mechanisms, we also cannot say that the proposal would tend toward producing efficient ones (as we could for POOLCO) based upon what it explicitly states. On the other hand, though, the Bilateral proposal is the most market-based of those considered in California. Consequently, one would expect that if more details were developed in the same spirit as the remainder of the proposal, efficient pricing mechanisms could result.

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[9]Hereafter, unless stated otherwise, "the Bilateral proposal" will refer to "the California Bilateral proposal."
[10]Knight, 1995, 89. It should be noted that Commissioner Knight is paraphrasing input from TURN (Toward Utility Rate Normalization) in this sentence.
[11]Knight, 1995, 32.

10.4.2 Market Structure Criteria

10.4.2.1 Market Structure Criterion 1

The Bilateral proposal calls for the competitive provision of ancillary services in a broader manner than does POOLCO when it suggests that competing firms would not be limited to supplying ancillary services to OPCO, but could also supply individual market participants directly. Transmission customers would also have the option of providing their own ancillary services. Despite its competitive bent toward ancillary services provision, the proposal makes no mention of transmission construction being signaled by market forces, let alone being built as the result of a market process. Instead, the Bilateral proposal charges OPCO with system planning responsibilities.[12]

10.4.2.2 Market Structure Criterion 2

The proposal seeks market efficiency through bilateral contracts which it envisions would lead to a truly competitive market, lower rates, and the fostering of innovation.

> Allowing customers to choose from an array of goods and services provides a better opportunity for them to find a service that best suits their needs. Lower costs will be achieved when customers have alternatives among suppliers and providers and can compare their prices and services.[13]

It also anticipates that aggregators would be another source of potential efficiency gains.[14] However, this reliance on bilateral contracts is done at the (unmentioned) expense of transaction costs. In a Bilateral proposal-based industry, customers would be required to become more sophisticated, system operation would become more complicated (since each of the contracts would have to be balanced), and generators would be required to have the expertise to enter into contracts and enforce them. While it is quite conceivable that the efficiency gains created by bilateral contracts would more than offset their transaction costs, it is disturbing that the proposal does not at least address the issue.

10.4.2.3 Market Structure Criterion 3

The proposal implies that transmission service terms and prices would be available to all in a non-discriminatory manner. It does so by summarizing the FERC's non-discriminatory access proposal and by indicating that OPCO would operate in compliance with Western System Coordinating Council (WSCC) standards.

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[12] Ibid., 32.
[13] Ibid., 49.
[14] Ibid., 50.

10.4.2.4 Market Structure Criterion 4

In its attempt to outline the development of a competitive ancillary services segment of the industry, the Bilateral proposal appears to ignore that some of the ancillary services are at least partially public/collective goods, and that as such, may require more centralized oversight than the proposal envisions. For example, because of the complicated technical interactions that occur in power flows, a market participant probably would not be able to provide for all of its load-following independent of OPCO. The proposal also appears to assume that market participants desire the provision of these services, while in fact, there are significant disincentives for any particular party to provide them (since they are collective goods). Although its handling of ancillary services is innovative, the proposal does not seem to grasp the difficulties that could occur when it essentially transforms public goods into private goods. Furthermore, while the proposal implicitly identifies the functions of OPCO as being public/collective goods, it does not describe how OPCO would be funded.

10.4.2.5 Market Structure Criterion 5

The Bilateral proposal's emphasis on customer choice would allow electricity consumers many opportunities for efficient service. In the process, however, it would also offer customers many opportunities to be confused. In an attempt to minimize confusion, the proposal offers all consumers the option of selecting "utility service customer" status. Other than the anticipation of lower rates, this type of service would appear to customers as being little different than their current service. Nevertheless, these customers would undoubtedly be contacted by aggregators and perhaps even generators who would offer much more "complicated" proposals. To the extent that customers make inefficient choices based upon their confusion, an economic problem is created. While the market's invisible hand would provide an incentive for marketers to simplify their offerings, it would also provide a countervailing force to maximize the benefits of aggregation, especially since the confusion efficiency losses would likely be a second-order effect. The ongoing complaints about the "complicated" nature of deregulated telephone service and airline fares (epitomized by a recent proposal in Washington to mandate simplified airfare structures) could be a precursor to discontent with electric power choices. Policy-makers must make an economic trade-off between confusion-related efficiency losses and the efficiency gains created by the increased opportunities resulting from increased choice. This is not a simple trade-off to make because the political issue of equity must also be factored into the equation. Large, sophisticated customers would likely benefit from increased choices, while, poorer, uneducated, smaller customers would not take less advantage of the benefits and could easily become confused, perhaps even swindled by an unscrupulous aggregator.[15]

10.4.3 Regulatory Criteria

10.4.3.1 Regulatory Criteria 1 & 2

The proposal appears to match the industry's technical characteristics with appropriate regulatory structures. Generation would become a competitive enterprise, subject to little CPUC oversight. Distribution would remain a regulated monopoly, although it would be subject to performance-based regulation, rather than rate-of-return regulation (ROR).[16] The Bilateral proposal does not describe how transmission would be regulated, except to say, in one passing comment, that the FERC would have authority over it.[17] With that being the case, another criterion is met -- that the body regulating transmission have a system-wide perspective.

10.4.3.2 Regulatory Criterion 3

The proposal mentions technological innovation in two of its core objectives. It argues, based upon the experiences of other deregulated industries, that a bilateral structure would promote innovation. What is not clear in the Bilateral proposal, however, is the means by which innovation would be fostered in the areas of the industry that remain regulated -- such as transmission and distribution. Implicitly, the proposal assumes that the market-shaped industry structure would evolve to meet technological changes.

10.4.3.3 Regulatory Criterion 4

By mandating that OPCO "dispatch" plants and operate the system according to contract provisions, rather than according to the actual, temporal operating costs of generators and the constraints and costs of the transmission system, the Bilateral proposal could lead to technical and economic inefficiencies. While the transmission pricing system could do much to override these inefficiencies, the proposal does not indicate how it would price transmission services. Supporters of bilateral models argue, in response, that bilateral contracts, through trading, would converge to the same or even more economic dispatch of the system (than in Pool-based, centralized dispatch systems).[18] An implication of this argument is that it underscores the importance of ensuring that all grid externalities are internalized into a transmission pricing system.

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[15]For a more detailed discussion of these issues, see: Loughran, 1996.
[16]Which would replace rate-of-return regulation.
[17]Knight, 1995, 39.
[18]Tabors, 13 November 1995.

10.4.4 Transition Criteria

10.4.4.1 Transition Criterion 1

The Bilateral proposal would allow utilities to receive compensation for 90% of their stranded generation investments and 100% of stranded regulatory assets and QF wholesale contracts. The 10% "penalty" on uneconomic generation assets is intended to provide utilities with an incentive to minimize their stranded generation costs and to "share the pain" of the transition.

10.4.4.2 Transition Criteria 2 & 3

The proposal addresses the issue of market power and proposes a radical solution to it -- the IOUs would be required to divest all of their generation assets. This requirement would alleviate vertical market power concerns,[19] and with them, reduce the amount of regulatory oversight necessary in the post-divestiture era. While it does examine the amount of market power that the utilities possess, the proposal does not address the necessity of such a radical move -- both in terms of the potential for market abuse and the economic inefficiencies (i.e. subeconomic prices paid for assets) that could accompany such a drastic action.

10.4.5 Long-Term Transmission "Production" Criteria

Because the proposal cedes transmission system regulatory oversight to the FERC and provides few other details on transmission regulation, it is difficult to glean what types of incentives would exist for minimizing long-term transmission production costs. However, by explicitly expecting that third parties would compete with the OPCO for the provision of ancillary services, the proposal would provide a market discipline on at least some of the system's operating costs.

10.4.6 Other Analysis

As was true of POOLCO, the lack of details on crucial issues makes the Bilateral proposal difficult to evaluate conclusively on the basis of our criteria. By not having developed transmission pricing mechanisms, the proposal omits significant, if not the most important, determinants of the economic efficiency of a transmission system shaped in the proposal's image.

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[19]And horizontal ones as well, provided that the utilities sell their generation assets to a variety of buyers.

But not only is the Bilateral proposal as, if not more, vague than POOLCO with respect to important issues, it also appears to have been written without a strong grasp of either the operating (technical) nature of the system or of the difficulty of implementing some of its provisions. For example, much of the (scant) information regarding transmission system operation is confusing, if not contradictory. The first point of confusion is that in one place, the proposal states that utilities would continue to be responsible for the provision of ancillary services.[20] This contradicts three other parts of the proposal. Specifically:

- The independent OPCO, not the utilities, would be responsible for operating the system;
- the utilities would be forced to divest themselves of their generation capacity, which would render them incapable of providing many of the ancillary services; and
- the proposal calls for competition in ancillary services and discusses multiple methods by which ancillary services could be procured by market participants.[21]

A second point of confusion occurs when the proposal states that utilities "would bear the duty to provide the comparable, non-discriminatory transmission, distribution and ancillary services necessary to support direct access."[22] Yet these utilities would lack the ability to fulfill that duty with respect to the first and third items since they would not have any control over the operation of the transmission system.

A provision that is likely more difficult to implement than the proposal recognizes[23] is the requirement that utilities divest all of their nuclear and hydroelectric plants during the two year period prior the start of direct access. Selling either of these sets of assets would not only require finding a buyer who is willing to pay an efficient price for them (which could be especially difficult for nuclear plants), but would also require approval from multiple federal agencies. Approval processes can be drawn out in a relatively non-contentious environment, let alone one where the stakes are high. It is reasonable to assume that Bilateral proposal opponents would view these proceedings as an opportunity to scuttle its implementation.

While the Bilateral proposal would not minimize transaction costs and would create the potential for inefficiency due to the forced divestiture of generation assets, an advantage

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[20] Knight, 1995, 24.
[21] Ibid., 41.
[22] Ibid., 25.
[23] It should be noted, in Commissioner Knight's defense, that in his "questions parties should consider in responding to this proposal," he backpedals a bit and asks whether a 1 January 1998 target date would allow sufficient time for the resolution of a number of issues, including "the task of separating utility generating assets." Source: Knight, 1995, 117-118.

that it has over the other two California proposals is that it minimizes regulatory costs -- both on the part of the CPUC and the utilities. By making a clean break between generation and transmission, it would entirely eliminate the risk of cost-shifting or self-dealing (and much of the need for oversight).

In summary, the Bilateral and POOLCO proposals share a key similar fault -- their paucity of details regarding important issues renders inconclusive the analysis of their impact on economic efficiency in transmission.

Let us next evaluate the California Final proposal.

10.5 EVALUATION OF PROPOSAL III: CALIFORNIA FINAL PROPOSAL

10.5.1 Transmission Pricing Criteria

Relative to the first two California proposals and in keeping with its billing as a "much matured description of market institutions...,"[24] the California Final proposal[25] includes pricing mechanisms which can be evaluated more easily by our transmission pricing criteria.

10.5.1.1 Transmission Pricing Criteria 1 & 2

The inclusion of congestion charges and spatial and temporal marginal costs in the proposal's pricing mechanism should lead to efficient transmission pricing. The ISO would make these prices transparent (to market participants)[26] by its calculation and posting of congestion and spatial and temporal marginal costs prior to the Power Exchange auction. This would provide a transparent price to all Power Exchange bidders before they formulate their bids. At the same time, these prices would be available to those engaged in bilateral contract transactions.

10.5.1.2 Transmission Pricing Criteria 3 & 4

The proposal explicitly recognizes that a system-wide pricing structure has many benefits.[27] By relying on a state-wide, marginal cost-based pricing scheme, the Final proposal should provide incentives for system-wide considerations in system operation and planning. These efficient short-term price signals should promote the technically efficient use of the grid; and, when used in conjunction with congestion contract rights, should also

[24]CPUC, D.95-12-063, 1.
[25]Hereafter, unless stated otherwise, "the Final proposal" will refer to "the California Final proposal."
[26]CPUC, D.95-12-063, 18-19.
[27]Ibid., 29.

send price signals for generation and transmission capacity construction. In fact, a reliance on market-based mechanisms for planning and constructing transmission and generation is explicitly desired by the proposal.[28]

10.5.1.3 Transmission Pricing Criteria 5 & 6

While the Final proposal mandates that congestion and spatial and temporal marginal costs be included in the pricing structure, it does not indicate a exact pricing mechanism. This might allow for changes in the pricing structure as the ability to accurately distribute costs improves. The proposal also avoids the problem of including assumptions about future costs or demand in the pricing structure by its use of temporally varying prices, while at the same time, granting long-term price protection through congestion contracts.

10.5.1.4 Transmission Pricing Criterion 7

No customer class would receive special treatment in the transmission pricing mechanism. Special protections currently granted elsewhere in the industry are low income assistance and baseline rates. The Final proposal would end the latter in order to reduce restrictions on the market,[29] while the low income assistance program would be maintained.[30] Funds for this program would be raised through a non-bypassable surcharge -- which should not provide perverse incentives to bypass the grid.

10.5.1.5 Transmission Pricing Criteria Summary

From this discussion, it would appear that the proposal is well on its way toward creating efficient transmission pricing mechanisms, although the exact transmission pricing mechanisms (which are not mentioned in the proposal) would have a significant impact on the efficiency that would result from the proposal's enactment and implementation.

10.5.2 Market Structure Criteria

10.5.2.1 Market Structure Criterion 1

The Final proposal takes several steps to promote competition in transmission services, although its ancillary services competition provisions are more limited than those of the Bilateral proposal. The ISO would directly provide the ancillary services best provided by a central entity itself or solicit their provision as a monopsonist (competitively whenever

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[28]Ibid., 38, 46.
[29]Ibid., 162.
[30]In the future, administration of these funds might be shifted from the utilities to an independent organization in order to level the playing field. Source: CPUC, D.95-12-063, 166.

possible). The ISO would offer the remaining ancillary services in an unbundled manner. A transmission customer could have its unbundleable ancillary service obligations met directly by the ISO,[31] by a third party, or through self-provision. Market forces would also shape the transmission service market through congestion contract rights. The proposal recognizes that these rights could lead to competition in the construction of additional transmission capacity. At the least, these rights would create a contestable market, which, in turn, would prevent utility transmission owners from stifling new transmission construction.

10.5.2.2 Market Structure Criterion 2

The proposal would offer market participants the ability to individually determine the transaction costs that they wish to incur. Those who choose to retain "utility service customer" status and who purchase power at average-price rates would see essentially no new transaction costs.[32] Likewise, generators and distribution companies who sell power solely to the Power Exchange would see relatively low transaction costs, comparable with those in POOLCO. On the other hand, market players who engage in bilateral contracts or other hedging agreements would see higher transaction costs (which would be the price for potentially greater financial gain).

10.5.2.3 Market Structure Criterion 3

The proposal seeks to ensure that all transmission customers would have open access to transmission pricing and service information. One of the ISO's responsibilities is to "make system data available quickly and on a comparable basis to all market participants."[33]

10.5.2.4 Market Structure Criterion 4

The Final proposal makes strides toward identifying and compensating for public/collective goods. For example, it implicitly identifies the ISO as a collective good. It also indicates that the ancillary services which cannot be unbundled for technical reasons would be provided by the ISO, and charged to all users of the system. While it makes a start, the proposal does not offer a complete funding mechanism for these goods. With regard to the ISO, it does not determine what type of entity it would be -- for profit, non-profit private, governmental -- nor the exact mechanism for funding its working capital. The proposal recommends that the ISO's revenues be raised through a volumetric or cost-based charge.

[31] The ISO may, in turn, purchase these through a competitive process.
[32] And thus even avoid the cost of a new meter.
[33] CPUC, D.95-12-063, 42.

The proposal leaves these details to the utilities to develop.[34] Thus, while the Final proposal makes strides in identifying and funding public/collective goods, more work must be done for it to satisfactorily addresses them.

10.5.2.5 Market Structure Criterion 5

The CPUC recognizes the importance of educating consumers about the new industry structure and espouses the creation of an educational trust. It does this, in part, because the Final proposal is even more complicated than the Bilateral or POOLCO proposals. The Final proposal offers a default "utility service customer" status, but even this features "complications," such as the choice of time-of-use or average price rate service.[35] With its sanctioning of hedging contracts and authorization of bilateral ones, the proposal would create a market structure that is complicated, almost overwhelming, to the unsophisticated customer -- thus creating the same potential problems that were mentioned in the evaluation of the bilateral proposal. At the same time, though, these "complications" would allow customers many opportunities for financial gain.

10.5.3 Regulatory Criteria

10.5.3.1 Regulatory Criteria 1 & 2

The proposal finds that transmission retains the characteristics of a natural monopoly, and as a result, the Commission believes that it should continue to be regulated. The FERC would have oversight of transmission facilities and of the operations of the Power Exchange and the ISO. In this arrangement, the regulators (the FERC) should have a sufficiently broad perspective to regulate the transmission system efficiently. The proposal would substantially reduce the CPUC's oversight of generation, which it views as a fully competitive market. The Commission would retain oversight of distribution service, which the proposal views as a natural monopoly. The CPUC would use PBR to fulfill its obligation to regulate distribution. In short, the proposal appears to pair the technical characteristics of the industry segments with appropriate regulatory regimes.

10.5.3.2 Regulatory Criterion 3

It is difficult to determine the proposal's likely impact on technological development in transmission. The competitive provision of ancillary services might lead to increased innovation, but the proposal does not state this as an objective.

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[34]Ibid., 64.

[35]As well as the near certainty of many calls from companies seeking to sign customers up for "more complicated" services.

10.5.3.3 Regulatory Criterion 4

The regulatory structure, though its pricing system, should internalize system externalities and lead to efficient system operation. The proposal notes that one of the four "immediate and lasting advantages" of the ISO's establishment is that, "there will be a consistent pricing system for the use of the common network facilities that prevents cost shifting and supports the competitive market."[36]

10.5.4 Transition Criteria

10.5.4.1 Transition Criterion 1

The CPUC attempts to create an equitable solution to the stranded investment problem through 100% recovery of stranded costs by utilities, although stranded generating assets would receive a discounted rate-of-return adjustment on them.[37] The intent of this discount is to provide utilities with an incentive to reduce their stranded investments and to share the pain and the benefits of the transition. Utilities would receive an adjustment to this discounting based upon the percentage of fossil generating plants that they divest.

10.5.4.2 Transition Criteria 2 & 3

Through this divestiture enticement, the Commission attempts to reduce the utilities' market power in generation. The proposal calls for Pacific Gas and Electric (PG&E) and Southern California Edison (SCE) to divest 50% of their fossil-fueled generating capacity by the end of the transition period. The Commissioners took this approach after extensive review of the potential for market power abuse by PG&E and SCE. Furthermore, through its call for continued regulation of transmission and the creation of the financially independent ISO, the CPUC attempts to eliminate the market power of transmission owners.

10.5.5 Long-Term Transmission "Production" Criteria

While the CPUC has proposed transmission pricing mechanisms, the FERC would ultimately regulate transmission rates and the operation of the ISO and Power Exchange. Because of the CPUC's lack of authority, the proposal is relatively silent on some transmission issues, such as the cost recovery for transmission assets, even though the Commission is concerned about such issues.[38] The method that the FERC chooses to use in handling cost recovery, etc. would play a major role in determining the incentives for long-term transmission "production" cost minimization. The proposal's ideas for

[36]CPUC, D.95-12-063, 29.

[37]Furthermore, uneconomic generation would be defined as returns less than 8.5%.

[38]Ibid., 45.

competitive ancillary service provision should place at least some downward pressure on transmission service pricing, however.

10.5.6 Other Analysis

Our criteria are better able to discern the probable long-term efficiency impacts of the Final proposal than they were for the Bilateral and POOLCO proposals. This higher degree of clarity is the result of the half-year of debate and discernment that occurred between the simultaneous promulgation of the POOLCO and Bilateral proposals and the Final proposal. However, it should be noted that while the Final proposal is more thoroughly developed, several relatively important issues have yet to be resolved. For example, the proposal charges the utilities with developing the congestion contract[39] and ISO & Power Exchange structure provisions. It also does not specify the exact transmission pricing structure. The mechanisms that are chosen on these and other issues would have a significant impact on the efficiency of the resulting system. Since, the proposal promulgates solid principles for their development, thus there is a high likelihood that efficient mechanisms would develop, but this is not guaranteed.

Moving away from California, let us next evaluate the Wisconsin Plausible Extreme model.

10.6 EVALUATION OF PROPOSAL IV: WISCONSIN PLAUSIBLE EXTREME MODEL

10.6.1 Transmission Pricing Criteria

10.6.1.1 Transmission Pricing Criteria 1 & 2

Through its use of "simple" rate structures, the Wisconsin Plausible Extreme model's[40] transmission pricing mechanism would be inefficient in both the short- and long-term. This mechanism would only incidentally reflect the marginal cost of transmission at any given location and at any given point in time.

10.6.1.2 Transmission Pricing Criteria 3 & 4

The construction of transmission lines would not be signaled by transmission prices but by a centralized planning process or the requests of market participants. In the latter case, it is not clear how those who request service would be charged (for their request). If the cost of the new capacity would be averaged into the system's transmission price, inefficiencies would result if each and every request were to be honored. But at the same time, it would

[39]Ibid., 38.
[40]Hereafter we refer to this as the Extreme model.

also be inefficient if only those who request new capacity pay for its construction, for two reasons. First, most grid users would benefit, at least to some extent, from additional capacity. Second, the large cost of transmission line construction would most likely erase any gains that the transacting, requesting parties would receive from a line's construction.[41]

Furthermore, inefficient generation siting would likely occur because the transmission pricing structure would not signal efficient locations for generators and the central planning process for generation construction would be eliminated.

10.6.1.3 Transmission Pricing Criteria 5 & 6

The Extreme model does not delineate a transmission pricing mechanism. As a result, some flexibility (with respect to future demand and costs) in the exact pricing mechanism could occur. However, the mandate for a "simple" pricing structure would preclude improvements to the pricing mechanism that would allow it to more accurately distribute the system costs (and therefore be inherently more complicated).

10.6.1.4 Transmission Pricing Criterion 7

All parties would be given the same treatment with regard to transmission pricing. Efforts to protect customers in other segments of the industry -- such as through the low-income assistance program -- should not lead to uneconomic bypass of the transmission system, as they would be paid for through a non-bypassable distribution fee.

10.6.1.5 Transmission Pricing Criteria Summary

The model's explicit rejection of marginal cost pricing is a significant liability with respect to our transmission pricing criteria. We find that it would likely lead to serious inefficiencies in the operation and planning of the grid.

10.6.2 <u>Market Structure Criteria</u>

10.6.2.1 Market Structure Criterion 1

The model calls for the provision of ancillary services through a competitive process which would establish the system operator (Poolco) as a monopsonist for ancillary service

[41]This is partially the result of economies of scale of transmission lines. In almost all cases it would be more efficient to build a line larger than the capacity needs of one power transaction since to build one only large enough to meet the needs of the requesters would be very expensive as it would be fighting the economies of scale.

procurement. This mechanism would appear to preclude self- or third party-provision of ancillary services. In addition, through its granting of an exclusive service territory to the Transco, the model would prevent any sort of competitive mechanism for constructing new transmission facilities.

10.6.2.2 Market Structure Criterion 2

As in the Final proposal, the Extreme model would allow market participants to choose the level of transaction costs that they deem most appropriate. Those participants who desire low transaction costs would participate in the Poolco's spot market power pool. It should be noted that by forcing individual service customers to choose a Retailco,[42] customers in the Extreme model would face a higher minimum transaction cost than in the Final proposal. On the other end of the spectrum, the Extreme model calls for essentially unlimited options with regard to bilateral contracts and contracts for differences. The model anticipates that these mechanisms would lead to the creation of a futures market as well as specialty contracts.[43] Some of these options would have high transaction costs, while some (like the creation of a futures market) would have relatively low transaction costs.

10.6.2.3 Market Structure Criterion 3

Both pricing (through the simple rates) and service standards would be available from the Poolco to all market participants.

10.6.2.4 Market Structure Criterion 4

The public and collective good aspects of the transmission system are implicitly identified as the function of the Poolco and the Transco, and the ancillary services. No mention of a funding mechanism for the Poolco is made. The Transco would be funded through a postage stamp rate. Ancillary services would be paid for by an adder to the spot market price and fees charged to bilateral transactions. Therefore, some, but not all of the system's collective goods have funding mechanisms proposed for them.

10.6.2.5 Market Structure Criterion 5

The model does not strike a good balance between simplicity and efficiency. At the retail level, the model calls for many Retailcos to compete to serve customers in the role of aggregators (energy service providers). These Retailcos would "offer different pricing

[42]Since there would not be an analog to the default "utility service customer" status.
[43]Wisconsin Public Service Commission, October 1995, 7.

mechanisms to meet individual customer needs."[44] While unsophisticated customers would face the vagaries (and the benefits) of the market without a default provider nor an explicit call for customer protection, the transmission pricing mechanism would be made as simple as possible. A state-wide postage stamp rate would eliminate the problem of pancaking rates and be very understandable, but would achieve this lucidity at a great cost to efficiency. It is rather perplexing that the model calls for simple transmission pricing mechanisms -- considering that those who procure transmission service (generally Retailcos and generators) would be rather sophisticated -- while residential users are expected to deal with more complicated options.

10.6.3 Regulatory Criteria

10.6.3.1 Regulatory Criteria 1 & 2

The Extreme model assumes that transmission would remain a natural monopoly which would be owned by a state-wide or regional transmission company and operated by an independent system operator (Poolco). Interestingly, the model does not indicate under whose jurisdiction the Transco and the Poolco would operate -- the FERC is not mentioned while RTGs and NERC are mentioned, but in an unclear manner.[45] Without the regulatory authority being made explicit, we cannot predict whether the transmission system would have sufficiently broad regulatory oversight. In the rest of the electric power system, regulatory oversight appears to be well-matched with technical characteristics. Generation and Retailco service are assumed to be competitive, and therefore would not regulated. Lineco distribution service, a natural monopoly, would retain Public Service Commission PBR oversight.

10.6.3.2 Regulatory Criterion 3

The Extreme model does not include considerations for stimulating technological innovation in transmission nor for adjusting the regulatory structure to meet them should they occur.

10.6.3.3 Regulatory Criterion 4

Through its use of simple pricing structures, the model would not promote the technically or economically efficient use of the grid, nor would it internalize externalities through

[44] Ibid., 9.

[45] This confusion is enhanced by a suggestion later in the EIS that a statewide public Transco would not be regulated by the PSC, but by another independent authority; and that a privately-owned Transco "would be regulated by the PSC in much the same way as the privately-owned electric utilities are regulated today." Source: Wisconsin Public Service Commission, October 1995, 311.

transmission pricing. The model would grant the Poolco some authority in operation procedures (i.e. adjusting for transmission constraints) that would increase the technical efficiency of the system. However, such procedures would only partially mitigate inefficiencies that result from "incorrect" pricing incentives.

10.6.4 Transition Criteria

10.6.4.1 Transition Criterion 1

Stranded costs would be calculated based upon the results of the mandatory utility generation asset sales, however no further mention is made of the issue. It is therefore unclear exactly for what and at what level the utilities would be compensated.

10.6.4.2 Transition Criteria 2 & 3

The model calls for the divestment of all utility generating assets through an auction or sealed bid process (although utility affiliates could bid for them). The Extreme model mandates divestment without an examination of the potential for market power abuse by the utilities. The model also fails to include stipulations regarding the increments of sale (how many generators would be sold together) and does not place limits on how many units individual buyers could purchase. As a result, divestiture could result in an even higher market concentration than exists in the present market structure. The model also does not weigh the remediation costs of the divestiture mandate.

10.6.5 Long-Term Transmission "Production" Criteria

There is little assurance that new transmission facilities would be built or maintained at least cost. The model is vague on how the Transco would be compensated for its ownership and maintenance of the system, except that its costs would be fully recovered and it would operate as a price-regulated monopoly.[46] The latter would indicate, although not necessitate that regulation be based upon a rate-of-return model (which does not necessarily lead to cost minimization).

10.6.6 Other Analysis

The Extreme model fails more of the efficiency criteria than any of the others. It does so largely because of its attempt to simplify transmission pricing. This highlights the tension that exists between creating a structure that is simple to use and one that is efficient.

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[46] Wisconsin Public Service Commission, October 1995, 8.

It is also interesting and disconcerting to note that not only is the model's impact on transmission technology innovation unclear, there is good reason to believe that it was not even considered during the model's formulation. Remember that, unlike the other proposals we are evaluating, the Extreme model was developed as a "straw man" in the Environmental Impact Statement (EIS) process -- to set one extreme of what could happen in restructuring and then evaluate the impact it would have on a variety of measures. One of the measures the Commission staff chose in its analysis was economic efficiency, which it then broke into sub-parts (criteria).[47] Technological innovation, either in general or specifically for transmission, was not one of these criteria. This could lead to the conclusion that technological innovation was not considered in the process of developing the model. Given the changes that are now occurring in the industry as a result of technological innovation, this would be a serious oversight.

While we focus our analysis on the economic efficiency of transmission, the Extreme model gives us pause to consider potential benefits that could be realized from a non-efficient transmission pricing scheme. For example, the analysis section of the EIS[48] mentions that a distance-insensitive transmission tariff could allow for more power exports or imports -- depending upon the number of suitable generator sites[49] in the state vis-a-vis its neighbors.[50] Such a pricing structure would also make it more feasible to build plants in remote locations, far away from population centers. The EIS nevertheless recognizes the inefficient incentives that would be created in the process. We mention this discussion because it highlights the trade-offs that policy-makers face and demonstrates why they sometimes make decisions that are not economically efficient, even when they are aware of the inefficiency of their policy choices.

Having now examined the state-level deregulation proposals, let us turn to an evaluation of the FERC Mega-NOPR.

10.7 EVALUATION OF PROPOSAL V: FERC MEGA-NOPR

10.7.1 Transmission Pricing Criteria

The Mega-NOPR's transmission pricing structure is divided into two temporal parts: the near-term (stage one), when all utilities would be forced to use FERC-established generic

[47]Ibid., 141.
[48]Ibid., 181.
[49]With suitability not being defined by the economic or technical characteristics of the transmission grid.
[50]Depending upon how one balances the economic gains of power plants with their environmental impacts, and where the most suitable sites are located, this could be a benefit or detriment.

rates, and the long-term (stage two), when utilities would use FERC-approved pricing systems that they develop individually. The intent is to have utilities submit stage two rates in a staggered fashion, at their own initiative. The route is chosen because the FERC believes there would be a long regulatory lag if all transmission utilities were required to have their individual rates approved at once, and hopes that the stage one rates would be acceptable for many utilities for a significant period of time. While for the purposes of this thesis we are interested in evaluating stage two pricing structures, only the stage one pricing system is defined in the Mega-NOPR. As a result, we need to remain cognizant of the distinction between the short- and long-term, and while we comment on the stage one rate structure, we must remember the stage two is of equal, if not greater concern.

10.7.1.1 Transmission Pricing Criterion 1

During stage one, the Mega-NOPR would continue the practice of using uneconomic "postage stamp" rates. Because these rates are spatially and temporally insensitive, they bear little resemblance to the marginal costs of system operation. In stage two, there would be an incentive for utilities who make extensive wholesale power sales to develop marginal cost-based rate requests to the FERC because the utilities would have to use these rates for their own power sales. However, it is not clear that all utilities would have the same incentive to make such a switch; some would undoubtedly find the stage one embedded cost-based rates more attractive. One mitigating factor to this embedded-cost inertia is the ability of transmission customers to propose new rate structures.[51] What can be concluded from this discussion is that marginal cost pricing might develop in the long-term, but a quick convergence to it is not expected.

10.7.1.2 Transmission Pricing Criteria 2

While all participants would have an <u>equal opportunity</u> to see the system's marginal costs, the extent to which they can <u>actually see</u> the marginal costs would be determined by the correlation between pricing and marginal costs, as discussed above.

10.7.1.3 Transmission Pricing Criteria 3 & 4

While this implication is not discussed in the Mega-NOPR, the requirement of offering both non-firm and firm service would <u>allow</u> for short-run and long-run marginal cost transmission pricing, respectively. If its potential is utilized, the benefit of this dual rate structure is that efficient price signals <u>could</u> be sent for both the location of generation and transmission assets and the short-run use of the system. However, the resulting efficiency

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[51]FERC, April 1995, 17719.

would depend upon how utilities formulate their non-firm and firm rates and what standards the FERC uses to evaluate their formulations. Unfortunately, based upon what is said in the Mega-NOPR, the FERC does not appear to recognize the potential for marginal cost pricing. It only mentions that non-firm service would be interruptable and tariffed at a lower rate -- it does not equate non-firm pricing with short-run marginal cost pricing (nor does it equate firm service with long-run marginal cost pricing). Thus, it is not clear that the FERC would encourage utilities to engage in short-run and long-run marginal cost pricing, despite having provided a template for doing so.

Furthermore, the extent of flexibility that the Mega-NOPR gives customers could be a source of inefficiency. By giving customers almost unlimited flexibility in the length of transmission capacity reservations, the choice of firm and non-firm service, the option of network or point-to-point service, and the ability to request new capacity expansion, transmission customers would be given wide latitude to evade the full costs of running the system and the economic impacts of their transactions on the system. This cost-evasion capability, combined with the fact that transmission grids are intentionally built with excess capacity[52] -- they are not intended to operate in a congested fashion -- leaves open the possibility for insufficient funding of transmission investments.

For example, the ability of customers to procure non-firm service over unlimited time periods would appear to be especially problematic. There are some clear benefits to allowing short-term, non-firm service, such as maximizing use of the system by allowing short-term, beneficial transactions that would be uneconomic if the full cost of the system were incorporated into the transmission tariff.[53] In essence, this signals efficient short-term use of the system. However, non-firm pricing turns into a free-rider problem when parties are able to use transmission facilities without paying for their capital cost on a long-term basis. In situations where congestion does not exist and would likely not exist in the foreseeable future, there is little reason for a long-term transmission customer to opt for higher-priced firm service rather than lower-cost non-firm service. Yet the Mega-NOPR would give the customer this option.[54] The proposed development of a secondary market for transmission service could even further lower the incentive of "free riders" to purchase

[52] This is done for reliability reasons and because unconstrained transmission lines have fewer externalities (i.e. power dissipation, reactive power, etc.).
[53] Remember from Chapter 2 that the fundamental short-run pricing principle is that which equalizes short-run marginal cost pricing across the grid. See Section 2.4.5.2 (short run marginal cost pricing) and Kelly *et al*, 1987, 167.
[54] As mentioned before, this choice is economically efficient for the short-term transactions. However, it does not take into account the technical "absence of congestion" benefits.

firm capacity.[55] When balancing the savings of a non-firm contract and the credible "back-up" of being able to purchase capacity in the secondary market (albeit at a premium) with the price of taking firm service during the entire duration of the need for transmission service, the non-firm option might seem like a good risk in many cases. Furthermore, the customer could avoid having to go to the secondary market by purchasing firm capacity at a later point in time if it sees that capacity is being taken by other users. Even if a customer eventually decides to switch from non-firm to firm service, it would be a free-rider during the period it was taking non-firm service.

Exacerbating the problem further is the responsibility of utilities to make good-faith attempts to build new capacity when needed.[56] The consequence is that even if a customer bets wrong on non-firm service and does not take steps to protect itself in the secondary market, it might still have the opportunity to receive transmission service in the long-term. The Mega-NOPR attempts to deter customers from relying on requests for new capacity by assigning the customer with "financial responsibility for its share of the incremental expansion costs."[57] However, customers on low-usage lines might find the risk worth taking. A similar conclusion could be reached by customers on higher lines too, since the "threat's" inefficiency may make it non-credible. The economics of transmission line construction would make it inefficient to add capacity only to accommodate the needs of an incremental customer. When reinforcing an existing line or building a new one, there would be substantial benefit in adding additional capacity for further load growth and to relieve congestion. In relieving the congestion, other users on the system benefit (i.e. the technical externalities are reduced). But question then becomes, who would pay for this extra capacity? The existing users would already have firm service agreements at a specified price so they could not be charged. The incentives for purchasing firm service would decline with the creation of a new reserve margin so there would be a disincentive for the utility to provide it. At the same time, having the "incremental" customer bear the full cost of capacity expansion would squelch potentially efficient power transactions.[58] This would not lead to an efficient use of the system and would be orthogonal to the FERC's objectives of a more competitive wholesale power market. The result would be that either the utility would be forced to carry out its obligation to build new capacity

[55] Although for some it might raise the incentive to purchase it.
[56] FERC, April 1995, 17682.
[57] Ibid.
[58] This is especially true since the Mega-NOPR does not define what rights these customers would have. For example, would they receive firm capacity rights for the lifetime of the transmission line(s)? What say would they have in the future of the line -- i.e. could the utility take down the line in 10 years?

without the threatened "full" compensation from the marginal customer or the FERC's goal of wholesale competition would be forsaken. A potential transmission customer might assume that the FERC would rule in favor of the former. While the preceding argument is perhaps tangential, it illustrates that the Mega-NOPR's treatment of firm and non-firm pricing does not provide a consistent set of incentives for short- and long-term efficient transmission system use.[59]

Furthermore, it is not clear that the Mega-NOPR's division between firm and non-firm service would translate into short-run and long-run marginal cost pricing (which would be desired). In calculating the stage one rates, the FERC uses embedded cost pricing. While this would ensure cost recovery of the transmission facilities by the utilities, it would not promote efficient use of the grid. Utilities might be reticent to switch from embedded cost to marginal cost pricing because of the unfavorable incentives (such as the ones mentioned above) that the Mega-NOPR's provisions would create in a marginal cost pricing environment.

10.7.1.4 Transmission Pricing Criterion 5

The ability of utilities to update their transmission tariffs over time would allow for the use of more sophisticated pricing structures as they develop. The utility-by-utility method would also allow for the development and real-time experimentation with several pricing standards. For example, some utilities may choose MW-mile-based rates while others may choose nodal pricing. Since there is no clear consensus on what is the best and/or most feasible method for pricing transmission, the opportunity to experiment with different pricing structures could be helpful. However, the constraint that utilities have firm and non-firm, and network and point-to-point service tariffs might serve as a barrier to innovative pricing structures,[60] such as those that would place each participant on the same footing in order to incorporate considerations for congestion, etc. Another problem is that the utility-by-utility price structure method could easily create a grid where there are incompatible pricing mechanisms. If one utility uses a postage stamp rate while the neighboring one uses distance- and time-sensitive pricing, the grid could become confusing indeed, as well as rather inefficient. Customers could conceivably choose their "transmission provider" based upon how they could minimize their transmission payments (even though they would have the exact same power flows regardless of which

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[59]It is precisely these issues that are integral in the formulation of congestion contracts. See: Hogan, 1992; and Bushnell and Stoft, 1996.
[60]FERC, 24 April 1996, RM-96-11.

transmission provider they "chose"). While the FERC might argue that these issues are what motivates it to push for Regional Transmission Groups (RTGs),[61] it is somewhat troubling that the FERC is taking such a hands-off role on such important issues.

10.7.1.5 Transmission Pricing Criterion 6

The staged process would also allow for greater flexibility should demand or prices change drastically.

10.7.1.6 Transmission Pricing Criterion 7

In effect, the Mega-NOPR protects firm transmission customers by granting them the same priority status for transmission access as native load customers. This should not disadvantage firm service customers in any way. However this prioritization may be to the detriment of the native load customers (who are responsible for residual transmission costs as long as transmission assets are in the rate base).[62] While this probably would not create perverse incentives for the operation of the grid, it does raise equity issues.

10.7.1.7 Transmission Pricing Criteria Summary

In its stage one rate proposals, the Mega-NOPR clearly does not create an efficient industry structure, nor does it appear to move the industry toward one. This results from several provisions, most notably the use of embedded cost rates that are spatially and temporally insensitive. While in the long-term it is anticipated that there would be a move away from these inefficiencies, the speed at which this would occur is unclear, and the resulting situation -- a rebalkanization of the system, this time in terms of pricing rather than access -- is not particularly desirable. While this balkanization would allow for experimentation with pricing models,[63] it would nevertheless create hurdles in the formulation of wholesale wheeling contracts and could send perverse price signals. Another problem lies in the conflict between the desirability of marginal cost pricing and necessity of paying off the investments on transmission facilities. In the absence of congestion, the incentive for customers would be to purchase non-firm contracts which, in an ideal would, would reflect only short-run marginal cost (since this would allow for the maximum number of efficient transactions). However, by allowing long-term, non-firm service contracts on uncongested, unpaid for assets, a free-rider problem is created. In short, while many of the long-term details remain unclear, there is a high probability that the stage two pricing

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[61]And, in fact, the resulting inefficiencies may lead market participants to create more RTGs.
[62]Source: "Looking for Landmines in FERC's 'Mega-NOPR'," 14.
[63]For how this might occur, see: Kingdon, 1995, 229-230.

structures created under the Mega-NOPR's guidelines would not meet several of our most important transmission pricing criteria.

10.7.2 Market Structure Criteria

10.7.2.1 Market Structure Criterion 1

There are several mechanisms through which transmission service would be provided competitively. First, the Mega-NOPR calls for competitive provision of ancillary services whenever technically feasible. (In its description of the individual services, the proposal indicates the degree of competition that the FERC imagines could occur.) Second, the Mega-NOPR's mandated creation of reassignable firm transmission rights would create a competitive firm transmission service market.

10.7.2.2 Market Structure Criterion 2

The use of real-time information networks (RINs) with "published" tariffs should lead to low (marginal) transaction costs and should avoid the problem of reintegration through contract. Once firms have acquired the technological hardware and the expertise to use these standardized systems, the marginal transaction costs should be small. Furthermore, RINs, with their publicly available information, should reduce the costs of enforcing contracts by limiting the ability of parties to renege on their commitments.

10.7.2.3 Market Structure Criterion 3

One intent of the Mega-NOPR (and the primary purpose of RINs) is to ensure that price and service information is made available to all parties in a non-discriminatory manner.

10.7.2.4 Market Structure Criterion 4

Through the Mega-NOPR's detailed discussion and delineation of six ancillary services and their pricing, the FERC attempts to identify and compensate for the collective goods aspects of the transmission grid. There is some question, however, about the success and accuracy of the FERC's work. Although many in the policy community consider the Mega-NOPR's list to be the definitive set, some in the technical community do not believe that it adequately spans the full complement of ancillary services that transmission utilities provide.[64] For example, researchers at Oak Ridge National Lab (ORNL) have identified 19 ancillary services (see Table 10.1 for a comparison of these two lists). The failure to identify (and compensate) for some services would create a disincentive for their provision.

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[64]Source: "Looking for Landmines in FERC's 'Mega-NOPR'," 15.

Table 10.1: Comparison of FERC and ORNL Classifications of Ancillary Services

FERC Ancillary Services	ORNL Ancillary Services
• Reactive power/voltage control	• System reactive power management and voltage control • Local reactive power management and voltage control
• Loss compensation	• Real-power-loss replacement
• Scheduling and dispatching	• Unit commitment • Economic dispatch
• Load following	• Load following spinning reserve • Reliability spinning reserve
• System protection	• Supplemental operating reserve • Stability enhancement reserve • Local area security • Transmission reserves
• Energy Imbalance	• Unscheduled energy
Services not identified by the FERC	• Time correction reserve • Nonoperating reserve • Black start • Metering, billing, and communications • Transmission monitoring and control • Repair and maintenance of network • Power quality

Source: Hirst and Kirby, 1995, 15.

Even more contentious than the definition of ancillary services has been the stage one rate structure that the Mega-NOPR proposes for their provision.[65] The proposal would assign a uniform 3% transmission loss factor for all wholesale transactions, with loss compensation charges set equal to 110% of the marginal cost of generation. A problem with this approach is that while a 3% power loss rate may be true for some transactions, transmission losses are a function of specific power flows, and can be much higher than 3%.[66] As a result, this blanket rate would bear little resemblance to the actual costs imposed by many transactions. Furthermore, this rate structure would send the most erroneous price signals at the worst times, since the lowest actual losses are most apt to occur on the least constrained lines and the highest loss rates are apt to occur on the most congested lines.

Energy imbalances would be handled by a ±1.5% deviation band, where any hourly average energy deviation within this band would be compensated for by an in-kind or incremental cost payment, while deviations outside that band would be subject to a 100

[65]This pricing structure is established in: FERC, April 1995, 17720.
[66]Office of Technology Assessment, 1989, 121.

mils/kWh charge. Hirst and Kirby believe that an hourly-averaged deviation would allow for significant gaming of the system.[67]

No extra charge would be made for scheduling and dispatching functions, as the Commission includes these in the fixed costs portion of rates. The Mega-NOPR assumes that transmission companies would retain responsibility for system operation. If ISOs operate transmission systems instead, the FERC should revisit the no extra charge for scheduling and dispatch provision.

The remaining ancillary services -- load following, system protection, and reactive power -- would be bundled into a single rate (since they are difficult to quantify) of 1 mill/kWh. Once again, a serious weakness of such a rate structure is that items such as reactive power vary *greatly* (i.e. orders of magnitude) from location to location.[68]

The aforementioned criticisms of the pricing policy mention just some of the concerns that exist in the industry. Although ancillary services are a small part of the $200 billion electric power industry, the consequences of inefficient pricing are significant because ancillary service provision costs utilities approximately $10 billion per year.[69] Pacific Gas and Electric (PG&E) calculates that the FERC-proposed ancillary services tariffs would consistently cover less than half of PG&E's cost of providing them.[70] If these calculations are accurate and representative of the entire industry, transmission providers *could* lose $5 billion or more per year. This would indicate that there are significant problems with the Mega-NOPR's stage one compensation plan for ancillary services. If the inefficiencies created by the rate structure are as large as PG&E predicts, utilities would have a significant incentive to propose their stage two rates quickly. Nevertheless, the magnitude of potential losses is troubling and rapid rate filings by utilities would defeat the intent of the Mega-NOPR's two stage process.[71]

10.7.2.5 Market Structure Criterion 5

Through its use of posted transmission tariffs on standardized systems, the Mega-NOPR would create a structure that is relatively easy to use from the customer's perspective, with little loss of economic efficiency.

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[67]Hirst and Kirby, 1995, 17-18.
[68]Ilic, 18 September 1995.
[69]Hirst and Kirby, 1995, 16.
[70]Mara, 1995.
[71]FERC, April 1995, 17719-17720.

10.7.2.6 Market Structure Criteria Summary

It would appear that the FERC has taken positive steps toward creating an efficient market, although further study, discussion, and policy refinement is necessary (and has occurred). Work is especially needed to address inadequacies in the definition of and compensation for ancillary services.

10.7.3 Regulatory Criteria

10.7.3.1 Regulatory Criteria 1 & 2

The Mega-NOPR states that transmission retains and is expected to retain natural monopoly characteristics. Consequently, the FERC would continue its regulatory oversight of it. Given that the FERC has a national perspective, it should be capable of regulating transmission systems with a system-wide perspective. The FERC intends to continue to regulate wholesale power generation as well, at least in the short-term. However, the Mega-NOPR elucidates the FERC's ultimate desire of creating a market-based wholesale generation market over which it would conduct only light-handed regulation.[72] The states are left with the task of regulatory oversight of distribution functions. This approach appears to match the technical characteristics of the industry segments with appropriate regulatory oversight.

10.7.3.2 Regulatory Criterion 3

The Mega-NOPR does not appear to recognize the potential for technological change in the transmission segment of the industry -- it makes no mention of it and does nothing explicitly to attempt to foster it.

10.7.3.3 Regulatory Criterion 4

In the short-term (stage one), the Mega-NOPR would not ensure that externalities are internalized (per our extensive discussion on transmission pricing). Even in the long-term, it would appear that the Mega-NOPR, through its utility-specific pricing regime, would not internalize all of the externalities that occur on an interconnected transmission system. As mentioned above, this method could create an incompatible set of pricing incentives.

10.7.4 Transition Criteria

The twin tenets of the Mega-NOPR addresses the transition criteria.

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[72] Ibid., 17688-17689.

10.7.4.1 Transition Criterion 1

The FERC believes that "the recovery of legitimate and verifiable stranded costs is critical to the successful transition ... to a competitively-priced industry."[73] As a result, the Mega-NOPR calls for the full recovery of stranded investments that result from wholesale wheeling. Similarly, while the Mega-NOPR indicates that states have the authority to determine how to handle stranded investments that result from retail wheeling, the FERC encourages the states to allow utilities full recovery.

10.7.4.2 Transition Criterion 2

At the same time, the FERC believes that "market power through control of transmission is the single greatest impediment to competition."[74] The FERC has come to this conclusion as a result of its experience in regulating the industry and believes that market power is a continuing problem that requires action to alleviate.

10.7.4.3 Transition Criterion 3

The FERC chooses a moderate route in alleviating market power. By mandating the functional unbundling of utilities, while allowing for structural unbundling at some point in the future, the Commission avoids the potential efficiency losses that could result by turning loose $56 billion in assets.[75] At the same time, though, it chooses a course that could readily lead to more serious action should it be necessary to halt market power abuse.

10.7.5 Long-Term Transmission "Production" Criteria

Because a long-term pricing transmission structure is not articulated in the Mega-NOPR, it is difficult to know if incentives would exist for transmission "production" cost minimization. The competitive solicitation of some ancillary services should place at least a partial downward pressure on transmission rates, however.

10.7.6 Other Analysis

Another inefficiency of the Mega-NOPR is that its network service pricing provisions could lead to gaps between prices and the customers' "fair share" of embedded costs. According to the FERC's proposed pricing structures for stage one (and utilities would likely set analogous tariffs for stage two), network service customers would be charged an embedded cost rate based upon their average fraction of the total power on the system

[73]Ibid., 17689.
[74]Ibid., 17664.
[75]Energy Information Administration, December 1993, 46.

during monthly customer coincident peaks. However, when there are multiple network service customers, counterflows -- which effectively reduce the amount of power that a customer sends over the transmission system -- result. Consequently, the effective amount of transmission capacity used by network service customers decreases (in almost all cases) as the number of customers increases, but, the capital recovery burden of network service customers would be insensitive to this.

An interesting contrast between the Mega-NOPR and the state proposals is that the FERC chooses to retain the utility transmission ownership and operation industry paradigm, while the state proposals we evaluate (and numerous others mentioned in Chapter 5) call for the formation of ISOs which would transcend the boundaries of utility ownership. Presumably, the ISO structure would take better advantage of system operation scale economies and would allow for more consistent pricing mechanisms. Instead, the FERC sees RTGs as the mechanism for solving the conflicting transmission pricing problem. While the pricing-Balkanized transmission system may serve as an incentive to form RTGs and for them (the RTGs) to develop a region-wide pricing scheme, a great deal of inefficiency could occur in the meantime.

Having now evaluated each of the five deregulation proposals, let us conclude this chapter by synthesizing the results.

10.8 Summary of Results

In Table 10.2 we outline the findings of our evaluation. By examining this chart and looking at our previous analysis, we see that the California Final proposal is the state-level restructuring proposal that is predicted to be the most economically efficient with respect to transmission in the long-term. The California POOLCO proposal appears to be more advantageous than the California Bilateral proposal. However, this comparison could best be described as incomplete. Although POOLCO appears to be more efficient based upon the criteria that could be evaluated, the proposals' ultimate relative efficiencies would be greatly impacted by more specific details that are not developed in the proposals. Thus, the Bilateral proposal could conceivably end up being more efficient. The Extreme model, largely due to its blatantly inefficient transmission pricing system, is the least efficient of the bunch.

Table 10.2: Summary of Evaluation Results

Criteria	California POOLCO	California Bilateral	California Final	Wisc. Plausible Extreme	FERC Mega-NOPR
Transmission Pricing Criteria					
Prices reflect marginal costs	Unclear	Unclear	Yes	No	No/Maybe
Price signals make marginal costs transparent	Unclear	Unclear	Yes	No	No/ Maybe
Prices efficiently signal location and timing of new generation and transmission according to system-wide considerations	Yes	No/ Unclear	Yes	No	No/ Unclear
Prices signal short term economically and technically efficient use of system	Unclear	Unclear	Yes	No	No/ Unclear
Pricing structures flexible enough to able to be upgraded with time	Unclear	Unclear	Yes	No/ Unclear	Maybe
Pricing robust to future costs and demand	Yes	Unclear	Yes	Unclear	Yes/ Unclear
Customer protection mechanisms would not create perverse incentives	Yes	Yes	Yes	Yes	Yes
Market Structure Criteria					
Competitive provision of transmission services	Yes	Yes	Yes	Maybe	Yes
Transaction costs are considered and minimized	Yes	No	Yes	Yes	Yes
Pricing and service information made available in an open and non-discriminatory manner	Yes	Yes/ Unclear	Yes	Yes	Yes
Public and collective goods aspects are identified and compensated for	Unclear	No	Yes/ Unclear	Maybe	No/ Maybe
Simplicity in structure without compromising economic efficiency	Maybe/ Unclear	Yes/ Maybe	Yes/ Maybe	No	Yes
Regulatory Criteria					
Types and degree of regulation match technical characteristics	Yes	Yes	Yes	Yes	Yes
Regulatory bodies composed with a system-wide perspective	Yes	Yes	Yes	Unclear	Yes
Dynamic, symbiotic relationship between technology and regulation	Unclear	Yes/ Unclear	Unclear	Unclear	Unclear
Regulation internalizes externalities and promotes efficient technical requirements for system operation	Yes/ Unclear	No/ Unclear	Yes	No	No
Transition Criteria					
Equitable treatment of bottleneck market participants	Yes	Yes	Yes	Unclear	Yes
Examination of market power	Yes	Yes	Yes	Yes	Yes
Balancing of efficiency costs of potential market power abuse and of mitigation actions	Yes	No	Yes	No	Yes
Long-Term Transmission "Production" Criteria					
Incentives for minimum construction and operation costs in the long term	Maybe/ Unclear	Yes/ Unclear	Yes/ Unclear	Unclear/ No	Unclear

NOTES: Yes = Proposal meets the criterion
No = Proposal specifically does not meet the criterion
Maybe = The efficiency implications were mixed or could not be determined
Unclear = Proposal details regarding criterion have not yet been developed

The FERC Mega-NOPR contains some significant uncertainties at best, problems at worst, with respect to our criteria. Its compliance with many of the most important criteria is doubtful. This is particularly troublesome since the Mega-NOPR would serve as the foundation for the transmission segment of the industry during (and after) the restructuring process. Fortunately, the FERC appears to recognize that the Mega-NOPR contains inadequacies and is striving to improve it during the rule-making process· which has extended for more than one year.

10.9 REFLECTIONS ON THE FINDINGS

10.9.1 Representativeness of Proposals

It must be remembered that in this thesis we examine five specific deregulation proposals, and in the process, attempt to generalize our findings in order to answer larger questions, such as: are pool systems inherently superior or inferior to bilateral ones with regard to long-term economic efficiency in transmission? In order to do this, we are assuming that the proposals we evaluate are "representative" of the larger "frameworks"[76] of which they are a part. However, each proposal has its own wrinkles. This was evidenced in some of the weaknesses of Commissioner Knight's California Bilateral proposal, which were the result of specific details of his conception of a bilateral system, not necessarily inherent weaknesses in the bilateral framework. The same can be said for pool systems. A fundamental difference between the California POOLCO proposal and the British pool system[77] is that former considers market power issues while the formulators of the latter appear to have been blind to such issues.[78] An even more glaring example is the Extreme model, where its insistence on simple (and non-marginal cost) pricing causes it to "fail" our criteria more often than any other proposal. While the Extreme model is clearly inefficient, one could imagine that a framework which employs a state-wide or regional transmission company could offer the ability to be as efficient as the other the proposals with respect to transmission pricing.[79] However, based upon the specific, glaring weakness in the specific model we evaluated, we could come to negative findings on the larger framework of which it is a part.

[76]A framework is here considered to be a broad category of deregulation proposals, such as: pool-based, bilateral contract-based, single transmission company-based model. Within each framework would be a number of specific proposals. For instance, POOLCO was just one of several pool-based proposals (many of which were quite similar) that were bantered about in California. Similarly, PG&E proposed a bilateral model which would be within the same framework as the California bilateral model, but differ in details.

[77]Henney, 1996, 23.

[78]In fairness to the British, they were facing many unknowns when they began their "real-time experiment" with deregulation.

[79]For example, one could hypothesize that with a single ownership structure, any potential pricing distortions that could result from multiple ownership of singularly operated system would be eliminated.

This discussion underscores an important finding of this thesis -- that the details do in fact matter.

10.9.2 Details Matter

In the preceding discussion we see how specific details of a proposal can drastically change our evaluation of its impact on the efficiency of transmission systems. The same basic finding (that details matter) was also observed earlier -- in our analysis of the California POOLCO and California Bilateral proposals -- where we found their performance with respect to many criteria to be "unclear." While we posited the direction that the proposals were leading with respect to efficiency (i.e. the POOLCO framework seemed slightly better), we could not make any definitive conclusions on their relative predicted efficiencies without knowing some of the details that are at a level one or two steps below what was included in the proposals. Depending upon the resolution of the details, it would be possible that a resulting POOLCO structure could be significantly more efficient with regard to transmission than the Bilateral one, or visa-versa. The most significant finding from this discussion, then, is that the decisions made when the details are developed -- mundane or boring to the masses as they may be -- are predicted to be more important in determining the efficiency of transmission in the restructured industry than the decision to adopt a POOLCO, Bilateral or other framework.

In saying this, we are not precluding the existence of an "optimal" framework. But our findings do indicate two corollaries. The first is that if an optimal framework exists, in order for it to produce superior efficiency results, it must be accompanied by optimal details.[80] Secondly, none of the proposals that we evaluate in this thesis have the combination of both of these items, at least according to our criteria.

10.9.3 Findings and Their Inconclusiveness

The result of this is that while we can rank-order the proposals in terms of their predicted long-term economic efficiency based upon our criteria, the lack of detail in all of them makes this rank-order sensitive to change. We can conclusively say that the California Final proposal is superior to the Wisconsin Plausible Extreme model. It also appears to be superior, in a less conclusive manner, to the California Bilateral proposal; and would be ranked higher than the California POOLCO model because of the latter's lack of clarity on

[80]This discussion is of course simplistic, in the sense that the way that a proposal is implemented plays a significant role -- probably equal to if not greater than design -- in its ultimate success. While implementation can be facilitated by the design of a proposal, it cannot be mandated.

key points. But the remaining rankings (i.e. which is 2nd best...) are very sensitive to the undeveloped proposal details.

From this discussion it would appear that the CPUC chose the best option of the four state-level proposals that we evaluate, based upon our criteria for long-term economic efficiency in transmission. While the California Final proposal may be the best option, it is difficult to determine the magnitude by which it is the best choice. In short, the thesis affirms the Commission's choice, but does not give it a "ringing endorsement."

Unfortunately, we cannot generalize this finding and determine from our analysis whether a hybrid framework is superior to the other frameworks. Most all of the problems that exist in the proposals are a result of the specific proposals, rather than in the framework that they represent. It is unclear whether these proposal-level problems mask more fundamental weaknesses with the frameworks, however.

10.9.4 Disregard of Technological Change

When one ponders the analysis, examines Table 10.2, and then thinks back to discussions earlier in the thesis, one is struck by the lack of attention that the proposals pay to technological change. In only two of them can one even *infer* the possibility of technological change in transmission. It is ironic that the Bilateral proposal, which we mention earlier is deficient in terms of its understanding of electric power systems, is the one that most explicitly discusses the value of technological change. Yet even its discussion of innovation in transmission technologies is a stretch -- it does so by arguing that, in general, innovation results from competition. The argument would continue by saying that the proposal attempts to stimulate technological innovation in transmission by introducing competition in ancillary services. While this argument may be a stretch, the only other place where technological change in transmission is implied is even a further stretch. The Final proposal contains two obscure references to potential future changes in the structure of the transmission system which could only result from technological advances.[81]

After having seen how the industry has developed as a result of technological innovation, this lack of attention to, let alone the lack of development of incentives for, technological innovation in transmission is distressing indeed. It is even more disconcerting in light of

[81]See Section 11.6.3 for further discussion of this.

our previous discussion of potentially revolutionary transmission technologies that are currently under development, and our discussion of how difficult it can be to dislodge older, less-efficient, capital-intensive technologies.

10.9.5 Transmission as a Natural Monopoly - At Least in Part

It is interesting to note that each of the proposals view transmission service as a natural monopoly, but at the same time, they each also seek to stimulate competition in at least some part of the "transmission" system. It is yet further interesting to note that there appear to be significant differences of opinion about which transmission functions could be made competitive. This is most strikingly presented in the following chapter (see Table 11.1). Some of the differences are the result of the varying industry structures. But others appear to result from differing beliefs on what is technologically feasible, and/or differences in the innovativeness of proposal developers. The consequences of introducing competition into some parts of the transmission segment of the industry are examined in more detail in the next chapter.

10.9.6 Neglect of Basic Economic Principles

Throughout the policy discussions of the inefficiencies of the present generation market structure, and of deregulating it, is the reiteration of the superiority of marginal cost pricing and the importance of efficient price signals. Yet, when we evaluate these five restructuring proposals, we find that these basic economic principles were virtually ignored with respect to transmission pricing. Only the California Final proposal clearly and consistently strives for marginal cost pricing and efficient price signals in transmission services.

Having now completed the first main objective of the thesis, to evaluate these five proposals based upon our criteria, let us turn our attention to the prospects for the development of non-utility transmission systems (NUTS), by answering the question: "Is it crazy to think about the NUTS option?"

Chapter 11
Is It Crazy to Think About NUTS?

Political economists have been reproached with too small a use of facts, and too large an employment of theory. If facts are wanting, let it be remembered that the closet-philosopher is unfortunately too little acquainted with the admirable arrangements of the factory; and that no class of persons can supply so readily, and with so little sacrifice of time, the data on which all the reasonings of political economists are founded, as the merchant and manufacturer; and, unquestionably, to no class are the deductions to which they give rise so important. Nor let it be feared that erroneous deductions may be made from such recorded facts: The errors which arise from the absence of facts are far more numerous and more durable than those which result from unsound reasoning respecting true data.[1]

-- Charles Babbage (1835)

11.1 INTRODUCTION

This thesis examines five proposals for electric power deregulation that, as sweeping as they may be, would deregulate only part of the industry -- generation and, in some cases, electricity sales/energy services. Transmission and distribution (T&D) would remain regulated, perhaps even more than in the past. But is it correct to assume that a deregulation "fire wall" can be built between generation and T&D? Would the attempt to do so even be efficient? In other industries, deregulation has "unleashed 'a gale of creative destruction' in which competitive forces could redefine market structure."[2] Why would the same not occur in electric power?[3] Nevertheless, there is nearly universal agreement that it is not possible to deregulate transmission -- that it is a natural monopoly, and as such, cannot be opened to competition. Yet, many other "special cases" -- segments of or entire industries that seemed impervious to competition -- have been deregulated with success. With these ideas in mind, the focus of this chapter is to examine the question: would it be possible, either now or at some foreseeable time in the future, for non-utility transmission systems (NUTS) to develop? To answer this question, we examine why NUTS might and might not be beneficial, the impediments and potential pathways to their development, and their future prospects.

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[1]Babbage, 1971, 156.

[2]Vietor, 1994, 310. Vietor borrows the "gale of creative destruction" concept from Schumpeter. For the original context of this statement (which is applicable to competition in general), see: Schumpeter, 1962, 84.

[3]Especially in transmission since the corresponding segment in the telephone industry (long distance) was the first to be deregulated, and since generation and transmission are, to some extent, interchangeable.

11.2 WHAT IS A NUTS?

Let us start by defining non-utility transmission systems. Given our earlier definition that "transmission" includes all the functions of transmission systems: "the wires," system control, and ancillary services (even those that are generation-based); the broadest definition of NUTS is that they are complete transmission *systems*, here defined as "complete NUTS."[4] According to this definition, complete NUTS would operate independently of the current grid (and other complete NUTS that might develop). As such, complete NUTS would create competing transmission systems -- consisting of separate lines and system control. While we keep complete NUTS in mind throughout this chapter, we also consider "partial NUTS" -- "transmission" functions provided by competitive (non-utility) firms (Nutcos)[5] on the same, existing transmission system. Thus, partial NUTS would create competing transmission services on the same transmission system. Specifically, we anticipate that the following transmission services could be operated as partial NUTS in the foreseeable future:

- ancillary services provided to a system operator;[6]
- ancillary services provided directly to transmission customers;
- transmission line ownership;
- transmission line construction;
- transmission system operation; and
- transmission service reselling.

Although we use the complete/partial NUTS terminology throughout this chapter, an alternative, although perhaps initially more confusing, convention might be worth considering. In switching to these alternative terms, "complete NUTS" would be simply "non-utility transmission systems (NUTS)", and "partial NUTS" would be "non-utility transmission services (NUTs)". We do not use the alternative convention here because the big "S"/little "s" difference might be too fine for the introduction of a new concept.

These definitions prompt the question, what is a utility? For our discussion, a utility is a firm that operates in a regulated environment:[7] it has its prices set through some sort of regulatory process, and competition in the services it produces is limited, if not prohibited,

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[4]Not to be confused with "completely nuts," although many might suggest that advocates of this type of transmission system would fit said description.

[5]Presumably, these would be firms other than the incumbent transmission utility, although they could include affiliates of other transmission utilities, similar to IPP affiliates of utilities.

[6]As we discuss below, it may not be possible to provide all of the ancillary services in a competitive manner.

[7]Borrowing from George Stigler, regulation here is defined as "the attempt by the state to use its legal powers to direct ... the economic conduct of non-governmental bodies." Stigler, 1981, 73.

by regulation or statute. With definitions of complete and partial NUTS in hand, let us examine the potential benefits of their emergence.

11.3 WHY MIGHT NUTS BE BENEFICIAL?

11.3.1 General Benefits from Competition

A distinguishing characteristic of the American economy has been its broad reliance on free market forces. Hughes and Hall note,

> Economic regulation has generally been limited to a few industries that are either natural monopolies or subject to other kinds of market failure. This practice reflects a faith in the superiority of free, unregulated, competitive markets wherever competition is adjudged feasible and effective.[8]

While most segments of the American economy have always fallen in the domain of the free market, membership in the "limited few" has been fluid, partially as a result of larger political trends. During the past two decades the political winds have shifted from a New Deal Era societal desire to err on the side of preventing market failure to a desire to take the leap of faith of competition. As Gardner and Gilson note, "Over the course of two decades the inertia of public policy has shifted from a force restraining to a force propelling deregulation."[9] This was precipitated, in part, by economists' predictions of the benefits of deregulation. Most of these early 1970s predictions have come true -- a recent estimate places the annual social welfare benefit from the deregulation of seven industries at $35.8 to $46.2 billion 1990 dollars. This amounts to an efficiency improvement of 7% to 9%[10] in the part of the economy affected by regulatory reform. Corresponding efficiency gains from electric power transmission deregulation would be approximately $160 million,[11] not taking account for cost savings that could occur in other segments of the industry (which, as we see below, could be much more substantial).

11.3.2 Instability of Partially-Competitive, Integrated Industries

The regulatory instability of partially competitive, integrated industries is another reason that the development of NUTS might be desirable in an industry structure that features competition in generation. Reflecting upon the deregulation experiences of other industries, Alfred Kahn comments, "Once you begin to admit competition, it introduces strains and distortions that can typically be resolved only by further deregulation."[12] For

[8]Hughes and Hall, 1990, 245.

[9]Gardner and Gilson, 1994, 18.

[10]Winston, 1993, 1284. The industries included in this estimate are: airlines, railroads, trucking, telecommunications, cable television, brokerage, and natural gas.

[11]This number is calculated by taking 8% of the total variable cost of transmission service. Data source: Energy Information Administration, December 1993.

[12]Kahn, October 1994, 27.

example, the pace of deregulation in the telephone industry started slowly, beginning with a series of small, incremental decisions; but once the Pandora's box was opened, it was impossible to shut. Deregulation continued after AT&T's divestiture. In 1984 it was intended that competition would be limited to long distance service, and that the Baby Bells would operate only within their own service territories. However, only several weeks after the divestiture agreement took effect, the Baby Bells were seeking entry into the long distance market,[13] and today AT&T is actively pursuing a strategy to get back into local service. The lesson is that pressures to push competition into transmission can be expected once generation deregulation occurs.

Furthermore, problems occur at the boundaries in industries that are mixed between regulation and competition.[14] McKie notes,

> Marking the boundary of regulation in these circumstances is a delicate task. To draw it too far out causes inclusion of some activities that competition could manage well, or perhaps better, and possibly suppress independent supply of those activities. To draw it too close in would cut across some activities that are organically incapable of separation without loss of efficiency and might permit some monopoly functions to escape control.[15]

This experience was borne out in the natural gas industry, as Vietor has observed,

> The issues raised by this case [natural gas] exemplify the problems inherent in applying ratebase regulation to just one segment of an integrated economic activity. Artificial jurisdictional boundaries either distorted the competitive position of the integrated firm, or broke down.

A root cause of the instability of partially deregulated markets is that firms operating under "regulated competition" face fundamental asymmetries between risk and earnings.[16] These asymmetries create a force that propels firms to remove their "regulated competition" status -- through political or technological change. These problems could be particularly acute for electric power transmission in the presence of a competitive generation market because, at least to some degree, transmission and generation are interchangeable. For example, congestion on transmission lines can lead to out-of-merit generation dispatch. Furthermore, many of the ancillary services -- which (following the FERC's lead) we have defined to be "transmission" functions -- are "produced" by generators.

There are already indications that the forces are in motion to bring competition into electric power transmission. The North American Electricity Reliability Council reports that,

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[13]Gardner and Gilson, 1994, 5.
[14]McKie, 1970.
[15]Ibid., 11.
[16]Vietor, 1994, 330.

> [I]n a few areas, transmission lines have been built by non-utility generators (NUGs) to deliver their electrical output to the utility systems...[17]

And Gardner and Gilson note,

> as with other cautious steps down the path of deregulation, small steps set in motion forces that then compel larger steps... When transmission becomes an economically priced commodity, then utilities will actually have grounds to compete in providing it to both suppliers and users, and a valuable market will develop.[18]

While this last quote may be based upon an overly simplistic view of the technical nature of transmission systems, it captures the tendency of market forces to free firms from the complications that arise in mixed regulatory structures and applies it to transmission.

11.3.3 Spur Further Power Transactions

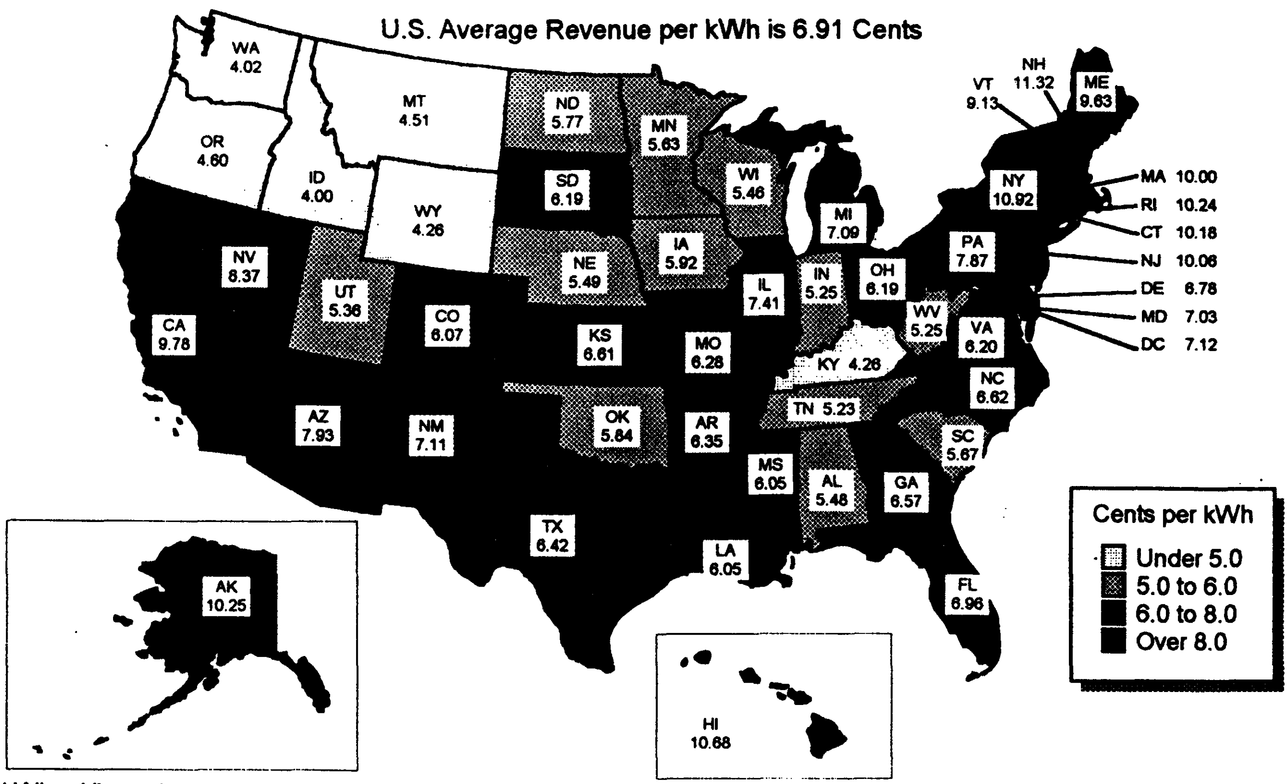
Perhaps the largest potential benefit of NUTS is that entrepreneurial Nutcos might facilitate beneficial power transactions that would not occur in the current transmission market structure, or even in the one envisioned by the FERC. There are two primary reasons that utilities might not facilitate these transactions. First, in a situation where utilities are functionally but not structurally unbundled, some utilities would have incentives to minimize wheeling across their lines so that they can maximize sales from their existing (often not paid for) generators. In such a case, the utility's transmission affiliate may neither deny nor unfavorably price transmission service to IPPs, but it would *deliberately* not actively facilitate transactions. Second, even if utilities do not intentionally refrain from actively seeking wheeling transactions, the historical roots of utilities and the traditional function of transmission systems within the utility structure,[19] could be a source of inertia that prevents an "entrepreneurial" transmission company from developing.[20] As a result, a utility transmission company may not *entrepreneurially* seek to increase the use of its system.

In contrast, based upon the experiences of NUGs, we expect that entrepreneurial Nutcos would actively attempt to create new transmission business. For example, a Nutco might encourage the construction of additional generation capacity to serve a high-cost region that would require the construction of both transmission and generation capacity. The willingness of the Nutco to build capacity may make opportunities for generation

[17]North American Electricity Reliability Council, 1990, 30.
[18]Gardner and Gilson, 1994, 18.
[19]To coordinate existing and future generation and load needs.
[20]In the preceding paragraph this is due to an implicit corporate policy, in this paragraph the argument concerns cultural factors.

companies transparent that had previously been hidden due to the lack of a transmission link. Nutcos could also find innovative ways of soliciting new business for their existing lines. While it is difficult to predict all of the mechanisms by which Nutcos could increase socially efficient trades, the existence of Nutcos would create incentives for the imagination of the market to consummate them.

Figure 11.1: Average Retail Electricity Price, All Customers (1994)



kWh = kilowatthour
Note: The average revenue per kilowatthour of electricity sold is calculated by dividing revenue by sales.
Source: Energy Information Administration, Form EIA-861, "Annual Electric Utility Report."

Source: Energy Information Administration, November 1995b, 24.

An example of how Nutcos could be beneficial can be seen by examining the electricity price differentials that exist between the Midwest and the Northeast. (See Figure 11.1) Often mentioned in discussions of deregulation, especially at the wholesale level, is that a more competitive market (and open transmission access) would allow low-cost Midwest utilities to sell power in the high-cost Northeast region.[21] Although the Mega-NOPR seeks to eliminate the policy constraints which prevent this from becoming reality, these discussions ignore physical constraints. For example, the peak power demand for the United States portion of the Northeast Power Coordinating Council (NPCC),[22] which includes New York and the six New England States, was 45,031 MW in the summer of 1989.[23] However, the maximum transmission transfer capability from American sources into the region was 2250 MW.[24] Thus, transmission system constraints would limit power imports to approximately 5% of the total demand. Clearly, this is insufficient to reduce New England power rates to the degree that many desire, and in the process, to maximize dynamic efficiency over the larger eastern interconnected region. Thus, even if the Mega-NOPR eliminates the policy barriers to Midwest to Northeast power wheeling, daunting physical constraints will remain.

Although important, alleviating these physical constraints is a non-trivial task since it would require capacity expansion and enhancement. However, there are currently few incentives, and possibly disincentives, for utilities to add capacity, especially for wheeling purposes. These disincentives are caused by uncertainties regarding transmission pricing and, consequently, the ability of utilities to recover their transmission investments. As a result of these uncertainties, which have become acute as the industry moves into a transition period, transmission capacity expansion activity has dropped significantly -- on the order of 50% -- and this trend is expected to continue until at least 2005.[25] These disincentives are magnified by the challenges of transmission siting. While the Mega-NOPR would empower potential electricity transactors to petition the FERC to mandate the construction of new facilities, the process would be daunting. In the case of Midwest to Northeast wheeling, petitioners would have to force multiple utilities to build new lines. These utilities, many of which would have incentives to drag their feet, would have to secure approvals from multiple jurisdictions. In short, this situation would be ripe for delays of years, if not decades. Furthermore, a quasi-collective goods problem would be created --

[21]For instance, see: "Electric Utilities to Provide Access for Competitors."
[22]The NPCC also includes five Canadian provinces.
[23]North American Electricity Reliability Council, 1990, 62.
[24]Ibid., 25. While these statistics are several years out of date, at the macro level (which is what they are intended to demonstrate) they are still representative of the situation as it exists today. Realize that exactly defining transmission capacity is a somewhat elusive concept. For more on this topic, see: Ilic´ *et al*, August 1996.
[25]North American Electric Reliability Council, 1992, 30; and North American Electric Reliability Council, September 1995, 23.

societal efficiency would be improved by building additional capacity, but the cost to potential transactors of "forcing" (through a litigious process) a series of utilities to do so would be a large, if not prohibitive.

In contrast, an entrepreneurial, profit-seeking Nutco would see the potential financial gain of long-distance power wheeling and act upon it. While it would still face significant siting obstacles, the firm's very purpose would be to construct the lines and operate them in a profitable manner. It would have a large incentive to have its capacity built as quickly as possible at the least-cost. Thus, the emergence of Nutcos could substantially improve the level of dynamic efficiency in the entire industry, when viewed at the level of the interconnected systems. Quantitatively, the benefits of this could be very substantial. For example, the FERC estimates that its open access transmission policies could save customers \$3.8 to \$5.4 billion per year[26] based upon the currently constrained network plus planned capacity expansions.[27] We expect that benefits of equal or larger magnitude could be realized from removing the transmission grid's physical constraints.

The most important point of this section is that entrepreneurial Nutcos could see, create, and seize otherwise unimagined opportunities for expanded use of the transmission system that would increase social efficiency. Nutcos could change the transmission operating paradigm -- from a relatively passive activity that focuses on reliability and support for the competitive generation segment of the industry, to one where significant opportunities for entrepreneurial growth could occur -- and in the process, create large efficiency benefits, potentially over areas as large as the regional interconnections.

11.3.4 Market Power Alleviation

By providing competing transmission service, NUTS could reduce or eliminate the market power of transmission companies.[28] The magnitude of this potential benefit is directly proportional to the amount of market power that transmission utilities possess. Prior to the passage of EPAct and the issuance of the Mega-NOPR, competition from NUTS would have provided large benefits. However, if the Mega-NOPR and state proposals achieve their goal of eliminating the market power of transmission utilities, this benefit of NUTS would also be eliminated.

[26]Source: "Regulators Issue Rules to Open Up Competition in Electricity Industry."
[27]Meroney, 9 May 1996.
[28]FERC, 1989, 108-116.

11.3.5 Spur Innovation

Based upon what has occurred in other deregulated industries, the emergence of NUTS could increase transmission technology innovation.[29] Gardner and Gilson comment,

> As new markets emerge, and as new refinements of existing markets are discerned, the pace of technological change accelerates. Rather than delaying technological innovation to fit cycles of asset depreciation, firms force innovation to establish a basis for market advantage.[30]

Absent NUTS and given the typical utility mind-set of standardization and conservative reliance on well-proven technologies, transmission utilities would likely be slow to embrace new transmission technologies. In addition, combining what Gardner and Gilson mention about depreciation cycles and the fact that transmission systems' operating costs are approximately 1/28 of their fixed costs,[31] utilities face financial disincentives to upgrading transmission technologies prior to the end of their (long) depreciation cycles. Thus, economic incentives compound the conservative technical inclination of utilities to deter the adoption of new transmission technologies, absent competition.

In contrast, the use of new technologies -- such as flexible alternating current transmission systems (FACTS) -- may be the only realistic entry strategy option for new transmission entrants. Without some type of technical advantage over existing systems, it is difficult to imagine how a Nutco could develop a comparative advantage vis-a-vis a traditional utility.

Another innovation-related benefit of new entrants is that they create new opportunities for innovative supply companies. Jorma Ollila, Chief Executive of Nokia Group, a cellular telephone equipment company, recently described how the international trend toward telecommunications industry deregulation is helping his company.[32] In the old era, telecom companies (analogous here to transmission utilities) had century-old working relationships with their equipment suppliers. Therefore, innovative (or potentially innovative) suppliers had no market for the new technologies they developed. However, the emergence of new entrants is creating new customers (without these century-old relationships) for innovative technology supply companies, which in turn, is stimulating innovation.

11.3.6 Successful Deregulation in Telephone and Natural Gas "Transmission"

The experience of other industries illustrates another potential benefit of NUTS. In both the telephone and natural gas industries, the segment of the industry comparable to

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[29] See, for example: Knight, 1995; Hughes and Hall, 1990, 245; and Levy, 1996, 89.
[30] Gardner and Gilson, 1994, 5.
[31] See Section 11.5.1.
[32] Ollila, 1996.

transmission has experienced at least some form of deregulation during the past 15 years. In the telephone industry, this was a near complete move toward deregulation. It was more limited in natural gas. As observed elsewhere, there are many physical similarities between telephone, natural gas, and electric power systems. Thus, the same substantial benefits achieved from the deregulation of these "transmission" segments of analogous industries *could* also occur in the electric power industry. (We emphasize "could" because despite the structural similarities between the three systems, there are also important differences between them.[33] As Ilic´ *et al* comment, "it is the presence of the transmission gird that makes the economics of power industry deregulation a qualitatively different problems than the deregulation problem of many other industries."[34])

11.3.7 Lower Transmission Costs

The emergence of competitive NUTS could lower transmission service rates through reduced variable costs.[35] While capital costs are the largest component of transmission service costs, ancillary services and maintenance costs are variable costs. We expect that Nutcos would be able to realize at least some variable cost savings, if for no other reason, because of lower overhead expenses.[36] If Nutcos could provide less expensive transmission service, utilities would likely find and eliminate some non-value-added costs in order to compete. Even if utilities were not to reduce their costs, Nutcos would offer a lower cost option to price sensitive customers.

11.3.8 Advantages in Project Finance

Non-utility generators have typically used a substantially higher debt-to-equity ratio in their project finance than their utility counterparts.[37] If this experience is a guide, Nutcos would likely use a larger percentage of debt in the financing of transmission facility construction than utilities currently do. While it does not necessarily follow that Nutcos would face a lower required return on investment, they could. Also, Nutcos would be free of utility commission oversight of debt-equity ratios, which should allow for added flexibility in transmission facility financing.

[33] See Section 1.1.2.1.

[34] Ilic´ et al, August 1996, 2.

[35] It should be noted that this benefit would likely produce a second order effect societal benefit.

[36] In 1991, administrative and general expenses accounted for 11.8% of total electricity costs. Presumably, in an unbundled industry, these will be partitioned amongst the functions of the utility. If they were spread evenly over generation, transmission, and distribution, the overhead costs of transmission would be larger than its O&M costs. Source: Energy Information Administration, January 1993, 31.

[37] Roseman, 1991, 35.

Despite these potential benefits, any discussion of NUTS is quickly dismissed as being infeasible.[38] Let us now explore the reasons for this pessimism.

11.4 IMPEDIMENTS TO (COMPLETE) NUTS

11.4.1 Natural Monopoly Characteristics of Transmission Systems

A belief that resonates through the literature is that "transmission qualifies as a classic 'natural monopoly'."[39] While this assumption may indeed be true, scant effort has been made to test it[40] -- perhaps because of the Herculean effort that would be required. While we do not attempt to rigorously test it here, we qualitatively probe the presumed natural monopoly characteristics of transmission.

11.4.1.1 FERC's Basis for Believing that Transmission is a Natural Monopoly

In the Mega-NOPR, the Federal Energy Regulatory Commission (FERC) discusses why it believes that transmission "remains and is expected to remain a natural monopoly."[41]

> The [natural] monopoly characteristic exists in part because entry into the transmission market is restricted or difficult. In addition, as unit costs are less for larger lines and networks, transmission facilities still exhibit scale economies. From an economic, environmental, and aesthetic viewpoint, it is often better for a single owner (or group of owners) to build a single large transmission line rather than for many owners to build smaller parallel lines on a non-coordinated basis. Further, effective competition among owners of parallel transmission lines is unlikely, and often impossible, with existing practices and technology.[42]

While the FERC's discussion of the natural monopoly characteristics of transmission captures a number of points, it does not include all of them. Let us dig a bit further in order to elucidate several more prescient points.

11.4.1.2 Joskow and Schmalensee Natural Monopoly Framework

In *Markets for Power*, Joskow and Schmalensee propound eight criteria for evaluating the natural monopoly character of the entire electric power industry.[43] Let us utilize their criteria (which take the form of questions) in order to better understand the natural monopoly characteristics of transmission. Because their evaluation was focused on the industry as a whole, some of their criteria would not be relevant to our evaluation exactly as

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[38]For example, see: FERC, 1989, 111.
[39]Weiss, 1975, 144.
[40]Very few extensive studies have been done on the topic. In the most extensive one found by the author, Huettner and Landon were unable to find, based upon 1971 economic data, that economies of scale existed in transmission. They note, however, that since generation and transmission are interchangeable; their data might have been corrupted by firms minimizing generation costs. Source: Huettner and Landon, 1978, 907.
[41]FERC, April 1995, 17675.
[42]Ibid.
[43]Joskow and Schmalensee, 1983, 32-33.

stated. In these cases, we alter the criteria's wording to have them fit our transmission evaluation while retaining the essence of the questions.[44]

11.4.1.2.1 Does the transmission of electric power have natural monopoly characteristics? This question is rather broad -- we attempt to answer it through our responses to the next seven questions.

11.4.1.2.2 If the transmission of electric power appears to have natural monopoly characteristics, what are the sources of the economies of single-firm production?
The natural monopoly characteristics of transmission occur at two levels: individual lines and the overall system. At the line level there are three sources of natural monopoly. First, the fixed and operating costs of higher voltage lines are substantially smaller per unit capacity than lower voltage lines. As a result, it is significantly less expensive to build one higher voltage line to serve a transmission corridor than to build multiple lower voltage lines to serve the same load. Second, building one line, rather than several smaller parallel lines, reduces siting expenses (e.g. costly hearings, litigation, and land purchases). Correspondingly, if a corridor's transmission capacity requirements substantially increase, it is less expensive -- in terms of siting and structural costs -- to reinforce an existing line (by adding another set of conductors or FACTS devices) than to build a new, parallel line. Third, transmission assets are very immobile due to "substantial investments in rights of way, towers, transmission lines, and switching stations."[45] As a result, immobility is a substantial barrier to exit that reciprocally acts as a barrier to entry.

The most fundamental natural monopoly at the system level results from the scale economies of system control and pooling. Transmission systems not only transport power from one point to another, they provide a vital coordination role in modern power systems -- they are the integrators of the electric power industry. In the words of Joskow and Schmalensee, "Transmission plays the most fundamental role in achieving the economies of electric power supply that modern technology makes possible."[46] It has been estimated that the economies of scale of power pooling are exhausted at approximately 10,000 MW.[47] In other words, a complete NUTS would need to be connected to a daunting 10,000 MW of generating capacity or potentially find itself at a scale economy disadvantage.

[44]For example, we change "does the supply of electric power" to "does the transmission of electric power."
[45]Joskow and Schmalensee, 1983, 125.
[46]Ibid., 63.
[47]Federal Energy Regulatory Commission (FERC), 1981, 10.

11.4.1.2.3 Over what stages of the transmission process: ancillary services, maintenance, transmission line ownership/construction/operation do natural monopoly characteristics extend?

We mention above that *individual* transmission lines have several natural monopoly characteristics. We also find that system operation and control is a natural monopoly with a high threshold for exhausting economies of scale. Currently, transmission system ownership and operation are typically bundled; however, it is the operation of system where scale economies exist *at the system level.* If ownership and operation were to be unbundled, it is conceivable that ownership would not display economies of scale, or at least not such large ones.

Because many of the ancillary services are generation-based, some of these may not have natural monopoly characteristics. However, it is dangerous to assume that all ancillary services are not natural monopolies. For example, reactive power support is an ancillary service that is spatially variant. In remote areas, localized reactive power support natural monopolies may exist. As a result, when we later recommend that ancillary services be made competitive to the greatest extent possible, the qualifying statement is important -- and both technical and economic considerations should be considered in evaluations of the feasibility of competitive ancillary service provision.

11.4.1.2.4 Are there important economies of vertical integration and coordination between stages that extend the natural monopoly from one stage to another?

Vertical integration in the electric power industry was undoubtedly once desirable. However, the current restructuring proposals are built upon the assumption that this is no longer true. With respect to transmission, for example, there may not be large benefits of having the same company own transmission assets and provide some of the ancillary services -- although centralized coordination of these activities is still desirable. Likewise, there may not be large benefits of having the same entity that owns the transmission system also own or dispatch generators. The technical nature of transmission systems require that there be coordination, although this could occur through "contractual arrangements," such as system operation protocols, rather than through the internalized decision-making of a single firm.[48] The ability to perform coordination functions outside of a single firm has been facilitated by technological improvements, especially information technology (IT).

[48]For more on contracts and internal firm decisions, see: Appendix J.8.

11.4.1.2.5 If the transmission of electric power does not have natural monopoly characteristics, what types of market behaviors and performance would be expected if price and entry regulation were eliminated?

We find above that transmission systems have some natural monopoly characteristics. As a result, we expect that if transmission were to be deregulated today, the market power abuse that the FERC is attempting to curb in its Mega-NOPR would continue, if not intensify. Utilities that are well-positioned for competition may be exceptions to this behavior, since they would have much to gain from an open access environment (or something resembling it). However, they would likely open up their grids as part of reciprocity agreements, rather than on a true "open access" basis. Utilities that are uncompetitive would likely refuse wheeling or levy transmission charges that would make their own generation price competitive with those of other suppliers.

If entry restrictions were to be removed today, before an industry restructuring, we would not expect the emergence of new transmission entrants. After a restructuring that would unbundle some transmission services, however, there would be some opportunities for Nutcos to enter into niche markets, such as the provision of some of the ancillary services.

In general, due to the scale large economies that exist at the system level, it is unreasonable to expect that complete NUTS could emerge without technological changes that undermine the natural monopoly characteristics of transmission systems.

11.4.1.2.6 Will we get competitive outcomes or oligopolisitic outcomes in the absence of regulated franchised monopoly?

Given the large capital requirements of transmission facilities and the complete penetration of the current market participants, it is almost inconceivable that anything but monopolistic outcomes would occur.

11.4.1.2.7 If natural monopoly characteristics are present but extend only over a subset of transmission functions, what kind of outcomes will emerge if price and entry regulation is eliminated in some stages of the process but not others?

As noted in our discussions of the restructuring proposals, some "transmission" functions -- specifically some of the ancillary services -- will likely be provided through competitive processes following restructuring. In the context of a utility-owned and operated transmission system there would be substantial opportunities for self-dealing in "competitive" ancillary service markets. As a result, it seems imperative that system operation and generation ownership be unbundled. But even with an unbundling of system dispatch -- which would take on the role of coordination of the "market" for ancillary services -- from ancillary service providers, there could still be opportunities for monopolistic behavior. For example, there may be a limited number of providers that could participate in a "competitive" process for the provision spatially dependent ancillary services. It may be that some services can be provided competitively in some areas but not in others. As a result, the process of determining which services can be made competitive will be important yet difficult.

11.4.1.2.8 What structural changes can facilitate competitive outcomes in transmission functions where natural monopoly characteristics are not present?

The provision of some ancillary services may not have natural monopoly characteristics. While work must still be done to determine exactly what mechanisms would work best, coordination by an independent system operator is likely necessary in order to create and maintain a competitive market.

A second area of potential competition is in the construction of new transmission lines -- either in a new corridor or one that is in need of a new set of transmission structures and conductors. While it is not feasible to have transmission lines operating in competition, it should be feasible to harness market forces in constructing and owning new lines, which would be operated by an independent system operator (ISO).

An implication from this discussion is that the Mega-NOPR's call for functional unbundling (which does not include the creation of an ISO) might not lead to competitive outcomes in some "transmission" functions that the FERC intends to unbundle, and may prevent the development of competition in some other transmission functions.

11.4.2 Transmission System Physics

Another impediment to the development of NUTS -- specifically competing parallel transmission lines on the same system -- stems from power system physics. In light of the above finding that system operation has huge economies of scale, one could ask, why not have "competing" transmission lines on the same system? After all, competing generators are connected to the same grid in the wholesale power market. While in the abstract there may be parallels between competing wholesale generators and competing transmission lines, there are important physical differences. Unlike the generation of electric power, where power output can be carefully controlled in an economically and technically efficient manner, the system operator does not control power flow paths through the transmission system. Instead, power flows along the path of least impedance and any attempt to alter this would be technically inefficient.[49]

Recognizing these physical constraints, let us hypothesize what would result if connected, parallel transmission lines were to compete. In this situation, competing transmission line Nutcos would solicit customers, but then would have no control over whether power flowed over their lines or the lines of their competitors. The result would be a substantial opportunity to "game" the system, which the FERC Mega-NOPR directly addresses.

> With two electric systems providing parallel contract paths, a share of the actual power flows would occur on each system according to the physical characteristics of the system. Thus, each of the two transmission service providers would have the incentive to underbid the other because the winner would receive all of the transmission revenues, but only incur a fraction of the costs. The loser, on the other hand, would incur the remaining costs, but would receive no revenues.[50]

This is clearly an unsustainable situation. The implication is that as long it is not technically and economically feasible to control power line flows, it is not feasible to have competing transmission lines on the same system. In addition, as long as system control and line construction in any given corridor have large natural monopoly characteristics, it is not reasonable to anticipate the development of competing transmission systems.

11.4.3 Siting Issues

We mention elsewhere that it is becoming increasingly difficult to site transmission lines, largely due to public concern about aesthetic, environmental, and health issues.[51] Despite these obstacles, most proposed transmission lines are eventually constructed, often by resorting to the power of eminent domain. States grant utilities this power when necessary because transmission lines are deemed to serve a public benefit. Correspondingly, eminent domain cannot be used for a private purpose.[52] The frequent need to employ (or threaten the use of) eminent domain powers to build transmission lines would lead to two complications if transmission were to become a deregulated, competitive industry.

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[49] It should be noted that in the event of emergencies the operator can control power flows by flipping a switch, but this is more of a "digital" control than an "analog" one.

[50] FERC, April 1995, 17675. See also: FERC, 1989, 111.

[51] It should also be noted that there is a trend that makes the construction of large-scale projects in general difficult, which includes a range of undertakings from highways to electric plants to pipelines. Source: Hansen, 1995.

[52] Wisconsin Public Service Commission, July 1995, 287.

11.4.3.1 Loss of Eminent Domain for New Transmission Construction

If complete Nutcos were to emerge, it could be argued that the construction of transmission lines would serve a private rather than a public purpose. Consequently, Nutcos would probably face the large barrier of having to construct transmission lines without the assistance of eminent domain powers.[53] Instead of having the force of law behind it, a Nutco would have to rely upon commitments from willing landowners and be required to purchase easements. Transmission lines would likely be sited on unproductive land, such as swamps and marshes, rather than along the most economically and technically efficient routes.

11.4.3.2 Implications for Current Transmission Lines

Lines that already exist could also face problems regarding eminent domain and the philosophically appropriate use of facilities build using it. As mentioned above, many transmission lines were built using eminent domain powers for a public purpose. However, in a competitive transmission industry, much of their public benefit would be transferred to a private benefit. As one commentator states, "Rights of way have been acquired, directly or indirectly, through eminent domain. Eminent domain proceedings, when they are needed, are brought in the name of, and for the good of, the people of the state involved, not the name of the utility directly."[54] As a result, there could be some opposition to having existing lines serve a competitive purpose (which would occur if the current grid were to compete with emergent NUTS). While this is more likely to be a philosophical stumbling block than a real impediment to transmission competition, it could be used as a political argument by those opposed to competition in transmission (or by Nutcos who would seek eminent domain fees charges the utilities in order to compensate the public and/or level the playing field).

11.4.4 Trend Toward Service Customization

A final potential impediment to the creation of complete NUTS is that such a move would go against the prevalent tides in the industry and society. Later in this chapter we postulate that the most realistic pathway to complete NUTS would be through an unbundling of the current transmission system functions (i.e. the creation of partial NUTS), and an eventual rebundling of transmission services in a competitive environment (i.e. formation of complete NUTS) after significant technological change occurs. It should be recognized that the definition of a "complete NUTS" might change during this unbundling/rebundling

[53] Wisconsin Public Service Commission, October 1995, 308-309.
[54] McDiarmind, 1995, 44.

process due to technological change. However, such a rebundling would run counter to what has happened in many other industries. The general experience has been that when deregulation hits an industry, services are continually physically unbundled and niches are discovered and filled with financial rebundlings. One of the reasons for this is increased IT capabilities, which eliminate many of the benefits of vertical integration. In some cases, customers value the unbundled services more than they do together. They may also take only some of the previously bundled services because they do not value the others.[55] As a result, this "natural" tendency against rebundling may serve as a significant impediment to complete NUTS development.[56] This would be especially true in the presence of electric service aggregators, who would be able to financially rebundle a broad range of services. Here the rebundling would not be a vertically-integrated physical bundling (as would occur in a complete NUTS), but bundling through a series of contracts that are flexible enough to meet the needs of individual consumers. In the presence of aggregators, quite simply, there might be no need for complete NUTS.[57]

11.4.5 Reflections on NUTS Impediments

It should be clear from this discussion that the impediments to complete NUTS are large, and that without fundamental changes in transmission technologies, their emergence is almost inconceivable. At the same time though, it appears that some transmission system functions (partial NUTS) could be provided on a competitive basis.

Having now examined why might NUTS be beneficial, and the impediments to their creation, let us look at why NUTS might be undesirable, even if they were to become technically feasible.

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[55] Gottlieb and Colucci, 1995.

[56] For a discussion of the evolution of the industry that sheds insight on this point, see: Warsh, 24 March 1996.

[57] In discussing the evolution of the industry, Joskow discusses the implications of PURPA, "PURPA maintained the traditional model of a utility as a "portfolio manager" that must acquire generating resources to serve the needs of its retail franchise customers which it serves on an exclusive basis. However, rather than meeting this obligation only by owning and operating its own generating facilities, utilities now had to look to QF suppliers to meet their needs as well." Source: Joskow, 1995, 35. It seems rational that the natural course of the industry's continued evolution, perhaps into a larger energy services industry, would have this portfolio management switch into the realm of financial aggregators, and away from physical aggregators. In which case, the need/benefits of complete NUTS would be diminished.

11.5 WHY MIGHT NUTS BE UNDESIRABLE?

11.5.1 NUTS Might Not Increase Performance Meaningfully

11.5.1.1 Relative Insignificance of Transmission Variable Costs

Driving the deregulation of generation is the belief that it will lower the cost of electricity, by forcing utilities and other generating companies to trim fat from their operating costs and to increase the use of new, lower-cost technologies. But fundamental financial differences exist between generation and transmission. In particular, fixed costs make up a much larger portion of the cost of transmission (than of generation). In 1992, the transmission operation and maintenance (O&M) expenses of 180 major U.S. utilities were $2.03 billion,[58] which amounts to 2.0%[59] of the variable cost of producing and distributing electricity. In contrast, generation O&M expenses were $74.9 billion,[60] which is 75.3%[61] of the variable cost of electricity. The relative gap is much narrower with regard to plant capital cost. The cumulative value of utility transmission plant is $56.9 billion[62] while generation plant is valued at $281.0 billion.[63] These statistics have two implications. First, at the absolute level, the potential reductions in transmission variable costs are trivial when compared with generation variable costs. Second, because of the high proportion of fixed costs to variable costs, new entrants have a limited opportunity to pursue the same strategy that IPPs have -- operate at lower variable costs than utilities.[64] They may be able to cut some variable costs,[65] but these savings could easily be insignificant. Consequently, when looking only at the transmission segment of the industry, the potential benefits of transmission deregulation would be relatively insignificant, at least with respect to the rationale that is driving generation deregulation.

11.5.1.2 Could NUTS Lower Capital Costs?

However, it could be asked, is there any way that NUTS could lead to reduced construction expenses (i.e. lower fixed costs)? One observer answers this negatively, "currently there is no evidence that private firms could site, permit or build transmission

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[58]Energy Information Administration, December 1993, 26.
[59]Ibid., 31.
[60]Ibid., 25.
[61]Ibid., 30.
[62]Ibid., 46.
[63]Ibid.
[64]It should be noted that far more important is the use of new technologies by new entrants. However, there are some organizational differences between IPPs and utilities which makes this sentence at least partially correct.
[65]Without an in-depth understanding of the cost structure of transmission utilities, we cannot conclude that Nutcos would be able to cut operating costs.

lines more cost-effectively than utilities, or with fewer environmental impacts."[66] It is possible that this observation does not take into account some of the factors that have allowed IPPs to build generating stations less expensively than utilities. For example, by actively courting the communities where they wish to build plants, and by being viewed as a entrepreneurial opportunity for a community (not as a quasi-governmental organization from which large concessions can be taken), IPPs have been able to reduce litigation costs, delays, and quasi-extortion payments.[67] The question then becomes, would the same be true for non-utility transmission? Perhaps, but there are two large differences between generation plants and transmission lines. First, a generating plant creates a number of local, permanent jobs; while the few jobs created by a new transmission line are likely to be less concentrated and less visible. Second, a generating plant may "impact" one community, a handful at most. In contrast, transmission lines could extend for hundreds of miles, affecting scores of communities. This makes close contact with those impacted more difficult. Thus, the process of "courting" communities much more difficult: because the benefits and communication efforts must be spread out over many more communities.[68]

11.5.1.3 System Considerations

Even if Nutcos resulted in (limited) financial benefits in the transmission segment of the industry, these benefits would need to be balanced against the potential system-wide impact of NUTS. For example, the FERC believes that transmission systems should be common carrier networks that support a competitive generation market. If the emergence of (complete) NUTS were to impair the functioning of competitive generation markets by creating a new set of grid fiefdoms, the relatively small benefits in transmission would probably not justify the inefficiency costs to the much larger generation market. We do not conclude that NUTS would cause a negative impact on the generation market (we propose earlier that the partial NUTS could have a positive impact on overall efficiency); however, the potential for it highlights the importance of looking at the entire electric power system -- not just the transmission component -- when making restructuring decisions.

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[66] Roseman, 1991, 35.

[67] Sources: "International Conference on the Future of Industry in Advanced Societies, Conference Report," 6-7; and Tabors, 19 October 1995.

[68] Conversely, not all communities are courtable -- for whatever reason there is latent opposition. In the case of a generator, an IPP is able to "walk away" from a hostile community. In contrast, because of the number of communities impacted by a transmission line, the probability of running into hostility is high, and the ability to walk away is much lower because working around one community would have impacts on many others.

11.5.2 Reduction of Power Pooling

A tenet of electric power system operation and planning is that power pooling has many benefits and is an activity with large scale economies. Two broad categories of benefits are economic power exchanges and reliability.[69] The construction of totally independent, complete NUTS could undercut pooling. In order to create a system that is large enough to take advantage of economies of scale, a complete Nutco would need to connect a large number of generators to its NUTS. Since the complete NUTS would be independent of the other power systems in its region, generators which could have been pooled together in one system would be operated separately. In such a case, some scale economies might not be exhausted. This could result in reduced reliability and could hamper the market's ability to utilize the most efficient combination of generators.

One remedy to these problems would be to design competing systems so that they could periodically interconnect in order to take advantage of socially efficient power trades and for reliability reasons. However, Nutcos would likely oppose such a practice, because if *de facto* circumvention of the centralized NUTS system operation became common, there would be a convergence back into one system. At the same time, though, aggregators, customers, and generators would probably not be willing to forgo beneficial power trades for the sake of the Nutcos. As a result, this undesirable feature of complete NUTS could be a large impediment to their creation.

11.5.3 Provision of Insufficient Capacity

11.5.3.1 The Capacity/Reliability Problem

It has been engineering practice to design and operate electric power systems in a manner that errs on the side of robustness in order to maintain high levels of service reliability.[70] Regulatory authorities have passed along the associated costs to ratepayers, who lacked the ability to send economic signals on their desired level of reliability. Analogous high levels of reliability and/or service existed in many of the industries that have been deregulated. The continued experience has been that many customers are willing to accept lower quality service in return for lower prices. Not surprisingly, there are many electric power customers who would be willing to accept lower levels of reliability in return for lower electricity prices.[71] In short, the emergence of transmission competition would tend to drive the price of transmission service toward its short-run marginal cost. However, when

[69]For a much more detailed list (of 15 benefits), see: FERC, 1981, 15-16.
[70]Termed by some as "gold plated" systems. See, for instance: Navarro, 1995, 398.
[71]Source: "Has Reliability Been Affected by Downsizing and Cost Cutting?"

reserve margins exist,[72] the short-run marginal cost is consistently less than the long-run marginal cost.[73] The implication of this is that the market would not provide these reserve margins -- unless their cost could somehow be included in the transmission price.

One could ask, if some customers do not value high reliability, then why should we be concerned that transmission deregulation would not provide "sufficient" reserve margins? One answer is that the reliability of all electric transmission customers is more intimately intertwined than in the other deregulated industries. In the airline industry for example, the decision of some customers to fly in coach class has little impact on those who fly first class. In electric power transmission, however, the power of all customers flows across the same facilities with no differentiation between the electrons. Richard P. Felak comments on these problems,

> Some significant facets of the overall existing electric power quality/feature are not readily physically separable, salable, or accountable -- wholly or partially -- to satisfy customers who may desire these differentiable options. In addition, full-service customers who might want to remain so could have some of their own power quality and/or cost characteristics impacted by the actual or hypothetical service differentiation to satisfy non-full service subscribers.[74]

In addition, a substantially robust grid may be necessary to maintain generation competition in a restructured industry. The FERC's Transmission Task Force posited, "a grid that meets only a modest standard of robustness runs the risk of unreliable operation and also the risk of not accommodating competitive power supply alternatives."[75] The root of these problems lies in the fact that transmission reliability is not only an individual good, but is also a collective good, whose benefits may not be fully attributable to users, or recoverable by suppliers (if charged as an individual good).

11.5.3.2 The Futures Market Solution?

It is possible that this discussion of reliability is overstated and is a relic of the thinking of the old era -- when demand was assumed to be insensitive to price, and utilities were *required* to provide customers with all the electricity they desired. These assumptions change in the presence of competitive markets. Futures markets have emerged to hedge against risk in other industries. Some of these sophisticated financial instruments are beginning to be brought to the wholesale power business[76] along with the creation of an

[72] In this case they are desired for technical reasons that customers cannot fully appreciate.
[73] FERC, 1989, 92.
[74] Felak, 1995, 61.
[75] FERC, 1989, 93.
[76] For example, see: Southerland, 1996.

electricity futures market.[77] In the new electric power era, customers could be offered differentiated levels of reliability through market mechanisms.[78] For example, those who are especially sensitive to power losses could construct on-site back-up power or purchase hedging contracts. Those who value reliability less could agree to have power supply curtailed when necessary -- in return for lower rates. However, the "public goods" characteristics of transmission system reliability create a potential for market failure or cost shifting. As a result, while market mechanisms may be sufficient to meet some customer desires, it is not certain that they would supply the reserve margins that, at least according to conventional wisdom, are necessary to ensure reliability and prevent the larger system from collapsing.

11.5.3.3 A Technical Solution?

Later we suggest that Flexible Alternative Current Transmission Systems (FACTS) could be a technical solution to the problem of reduced reliability resulting from smaller power pools caused by complete NUTS. The idea is to have independent, competing systems run in a manner that would allow them to interconnect via FACTS during system emergencies. The concept would be applicable here, too -- FACTS interconnections could allow competing NUTS to share reserve margin capacities. However, the ability to switch to another system in the event of an emergency might externalize the costs of system reliability. If competing systems believed that they could rely upon others during emergencies, an incentive to provide insufficient reserve margins would be created. As a result, the only way to garner sufficient funds to construct sufficiently robust competitive grids might be to internalize all of the reliability costs and not take advantage of the capabilities of FACTS. However, in turn, this would require larger reserve margins, making complete NUTS less economically viable.

11.5.3.4 Summary

There is a possibility that transmission system reliability may not be sufficiently provided for if competing complete NUTS were to exist. Market mechanisms and technological innovations may be able to solve this problem, but because of the public goods nature of reliability, it is not clear that they could eliminate all of the externalities of transmission reliably. This issue should be given more consideration should the emergence of complete NUTS become a real possibility.

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[77]Source: "In Search of New Commodities."
[78]Felak, 1995.

Thus far we have engaged in abstract discussions of the benefits, impediments, and liabilities of developing NUTS. Let us now turn to slightly less abstract discussions of the prospects for the development of NUTS.

11.6 Probable Impact of Deregulation Proposals on NUTS

Elsewhere in this thesis we extensively study and evaluate five proposals for deregulation. Let us now evaluate these proposals one more time -- this time with an eye on their probable impact on the development of NUTS.

11.6.1 California POOLCO Proposal

The California POOLCO proposal is based upon the assumption that "transmission retains the attributes of a natural monopoly."[79] The POOLCO proposal would keep transmission ownership in the hands of utilities but turn over system operation to an ISO.

There are several promising features of the POOLCO proposal with respect to partial NUTS. First, the proposal mentions in passing that the functional unbundling it proposes would create competition in ancillary service provision. Second, the proposal states that future transmission construction should be signaled through congestion pricing. While it does not specify how congestion charges would be collected, let alone the mechanism for funding construction, signaling transmission construction through congestion pricing could allow for transmission line Nutcos.

Therefore, while the proposal would keep existing transmission lines solely in the hands of utilities, the California POOLCO proposal should lead to the development of partial NUTS in ancillary services and could possibly spawn partial NUTS in new transmission line ownership. However, the development of complete NUTS in the foreseeable future would precluded by the mandatory ISO.

11.6.2 California Bilateral Proposal

The California Bilateral proposal anticipates that partial Nutcos would emerge in a "direct access" electric power industry. It explicitly recognizes that market participants would have multiple options with regard to the provision of their ancillary services: a generator could self-provide, purchase them from the independent system operator (OPCO), or purchase them from a third party. In short, these third parties (partial Nutcos) would be in competition with the OPCO[80] and each other for the provision of ancillary services. The

[79]California Public Utilities Commission, May 1995, 7.
[80]Knight, 1995, 41.

proposal also recognizes that individual plants could become dedicated to providing third party ancillary services, such as spinning reserves[81] and balancing/back-up services.[82]

The California Bilateral proposal calls for the creation of a state-wide OPCO, which would preclude the development of complete NUTS in the foreseeable future.

In addition to its advocacy of ancillary services partial NUTS, the California Bilateral proposal is the most encouraging with respect to creating new, more efficient industry market structures. This could make it more likely to spur the development of NUTS.

11.6.3 California Final Proposal

The California Final proposal is built upon the assumption that "transmission retains the attributes of a natural monopoly."[83] It furthers the transmission system's natural monopoly character by placing the system's operational control into the hands of a state-wide ISO, whose creation would appear to preclude the development of complete NUTS in the foreseeable future.

The future of partial NUTS is bright, however. The California Final proposal would allow for the development of a competitive ancillary services market. While some ancillary services, such as system control and load balancing, would be the ISO's responsibility (and would be paid for by all grid users), transmission customers could choose the provider of other ancillary services. The ISO would post a list of the unbundled ancillary services and its charges for them. Customers could opt to purchase these from the ISO or procure them independently.[84] In such a market we expect that ancillary services partial Nutcos would develop to fill the third party provision niche.

The proposal also calls for the creation of tradable congestion contracts, which would provide correct signals for system upgrades and would provide long-term price stability for those who depend upon the grid.[85] The proposal and some observers believe that these mechanisms would create incentives for outside investors (Nutcos) to build new transmission lines when congestion occurs.[86] Congestion contracts could also allow for

[81]Knight, 1995, 41.
[82]Ibid., 42
[83]CPUC, D.95-12-063, 94.
[84]Ibid., 40.
[85]Ibid., 38. Included in this lot would be IPPs and others who sign long-term power contracts.
[86]For example: Hogan, 19 October 1995; and Bushnell and Stoft, 1996. The proposal indicates that one method might be for the ISO to construct capacity itself.

the creation of transmission service reseller Nutcos, which would purchase transmission congestion contracts and then resell them.[87]

The California Final proposal includes two comments which are interesting, in that the CPUC appears to recognize at least the possibility of Nutcos developing at some point in time. They are: "we view distribution as a natural monopoly with respect to serving those customers who do not opt for self-generation or construct transmission and distribution facilities of their own;"[88] and "the ISO will operate as a monopoly (at least for the foreseeable future) ..."[89] The proposal does not further elaborate on these comments, however.

While the California Final proposal has the assumption that transmission is a natural monopoly at its core, by encouraging competition in some aspects of transmission service provision, it could stimulate the emergence of partial Nutcos in ancillary service provision, new transmission line ownership and construction, and transmission service reselling. In short, the California Final proposal foresees the development of a Nutco industry more than any of the other proposals we evaluate.

11.6.4 Wisconsin Plausible Extreme Model

In sharp contrast, the Plausible Extreme model is the most constricting with respect to NUTS. The model holds the implicit assumption that transmission is a natural monopoly. Consequently, it places transmission system ownership and operation into the hands of a single entity (Transco), which would be state-wide at minimum. The proposal explicitly precludes the construction of complete NUTS and of transmission line ownership partial NUTS in its statement, "all new facilities will be built and owned by the Transco, which would be a price-regulated monopoly with a statewide franchise."[90]

The competitive solicitations for ancillary services made by the independent system operator (Poolco) should stimulate the development of ancillary services partial Nutcos. Because the Poolco would be responsible for soliciting and providing all ancillary services (self-provision and third party service do not appear to be allowed), this competition would be more limited than under the rules of some other proposals.

[87]There is some opposition to such behavior, however. In fact, currently the FERC caps the reselling of transmission reassignment rights at the price paid to the transmission utility. Source: FERC, April 1995, 17685.
[88]CPUC, D.95-12-063, 94.
[89]Ibid., 63.
[90]Wisconsin Public Service Commission, October 1995, 8.

In short, the Plausible Extreme model is the least hospitable toward the development of NUTS of the proposals we evaluate. Not only would the options for partial NUTS be the most limited of the four proposals, the creation of complete NUTS would be explicitly interdicted.

11.6.5 FERC Mega-NOPR

The FERC Mega-NOPR is based upon the assumption that "transmission remains and is expected to remain a natural monopoly."[91] The Mega-NOPR also assumes the current market structure: transmission utilities who own and operate their transmission assets. With that being the case, the likelihood of transmission line construction partial NUTS is quite small. On the other hand, the proposal calls for competitive ancillary service provision whenever technically feasible, although the Mega-NOPR only speaks to the issue of competition in terms of transmission customers having the option of choosing self-provision, third-party provision, or provision by transmission utilities. The Mega-NOPR does not indicate that the transmission system provider should procure them on a competitive basis (even though the Mega-NOPR recognizes that some utilities procure them from third-party providers currently).[92] One possible reason for this ties back to a previous discussion -- that a "competitive" ancillary services market that supplies a non-independent system operator[93] would create large incentives for self-dealing.

Through the FERC's intent to create a "robust reassignment market,"[94] the Mega-NOPR could also stimulate the creation of transmission service reseller partial NUTS. As the Mega-NOPR states, "capacity reassignment, combined with assured access to firm transmission service, reduces the transmission provider's market power by enabling transmission customers to compete with the owner to some extent in the firm transmission market."[95] However, continued caps on the resale prices (set at the price paid to the transmission owner) would squelch the creation of this potential type of NUTS. Capacity reassignment markets would still develop, but resellers would not emerge to purchase capacity from transmission companies with the intent of making a profit.

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[91]FERC, April 1995, 17675.
[92]Ibid., 17684. Although competitive provision to the transmission system owner is not explicitly anticipated by the proposal, it is certainly possible that such could occur in Mega-NOPR-shaped restructured industry.
[93]The Mega-NOPR does NOT call for the creation of ISOs.
[94]FERC, April 1995, 17685.
[95]Ibid.

In summary, the Mega-NOPR calls the development of NUTS in terms of ancillary service provision and could lead to transmission service reselling Nutcos. However, it would appear to limit transmission construction, ownership, and system operation to the established utilities.

11.6.6 Evaluation

The future of partial NUTS looks promising indeed. All of the five proposals call for the provision of some transmission services (most frequently ancillary services) on a competitive basis whenever possible. The California Bilateral and California Final proposals envision competition not only *to supply* the Independent System Operator (ISO/OPCO) with ancillary services, but *to compete with* the ISO/OPCO. The California Final proposal appears to be the most amenable to the creation of partial NUTS, while the Wisconsin Extreme model is the least amenable.

Table 11.1: Likely Impact of Proposals on the Development of NUTS

Prospects for:	California Poolco	California Bilateral	California Final	Wisc. Plausible Extreme	FERC Mega-NOPR
Partial NUTS: Ancillary Services provided to ISO	Expected	Expected	Expected	Expected	Possible
Partial NUTS: Ancillary Services provided directly to participants	Possible	Expected	Predicted	Poor	Expected
Partial NUTS: Transmission Lines, Ownership	Possible	Poor	Predicted	Very Poor	Poor
Partial NUTS: Transmission Lines, Operation	Poor	Poor	Poor	Very Poor	Poor
Partial NUTS : Transmission Lines, Ownership and Operation	Poor	Poor	Possible	Very Poor	Poor
Partial NUTS: Reselling of Transmission Service	Poor	Poor	Possible	Poor	Predicted
Complete NUTS	Poor	Poor	Poor	Very Poor	Poor

Notes: Expected = The proposal explicitly calls for this
Predicted = The proposal explicitly anticipates this *could* happen
Possible = One could imagine how this *could* develop
Poor = This is not a foreseeable outcome
Very = The extreme of the proposals with regard to the possibility

At the same time, however, the future of complete NUTS looks bleak. All of the proposals assume that transmission is a natural monopoly. All four of the four state proposals, through their creation of some form of independent system operator, would essentially enlarge the scale of the most fundamental system natural monopoly characteristic and/or inherently suggest that the scale of system operation has not been appropriate in the past.

Based upon our evaluation, one could conclude that the current industry restructuring is the death-knell of any (slim) chance that there might have been for complete NUTS to develop. This may be a correct conclusion; however, despite the additional barriers that would be created by the restructuring proposals, the emergence of complete NUTS might yet occur, under the right conditions.

11.7 PATHWAYS TO COMPLETE NUTS DEVELOPMENT

By drawing upon various discussions in this thesis, we can make informed speculations on pathways -- industry events that individually or cumulatively could lead the industry down an incremental path -- to the development of complete NUTS. Here we present ideas on embarking points for these pathways. More speculative discussion -- regarding the routes that the pathways may take toward deregulation -- can be found in Appendix K. Let us begin by building upon the "Revised Garbage Can Model" interpretation of the events leading up to the current industry restructuring.[96]

11.7.1 Lessons From the Revised Garbage Can Model

11.7.1.1 Lessons From PURPA

An important implication of the PURPA story is that small incentives in the structures of today's deregulation proposals hold the potential for large changes in the future. Furthermore, these incentives need not be integral components of the restructuring proposals or legislation.[97]

One way to characterize the current restructuring proposals is that they are underpinned by an attempt to create a competitive generation market by maximizing transmission scale economies. While all of the restructuring proposals hold the fundamental assumption that transmission is a natural monopoly, we have seen how a competitive generation market evolved out of PURPA, an Act which assumed the continuation of the "old era's" fundamental paradigm for electric power provision.[98] This paradigm was an industry structure built upon an attempt to maximize economies of scale in generation at the plant level and predicated upon the assumption that generation was a natural monopoly at the

[96] See Section 3.3.

[97] Remember that the foci of PURPA were regulatory rate reform and the power to mandate power pooling.

[98] Even though PURPA inherently undermined it because by allowing non-utility generators on the grid, PURPA assumed that generation was either not a natural monopoly, or that there were "higher" objectives than harnessing the benefits of economies of scale.

system level.[99] These assumptions were undoubtedly true, once upon a time. But then separate revolutions occurred in public policy and technology that undermined the basis of this system. It should be stressed that these revolutions were mutually dependent -- it was a combination of *both* technological innovation and policy change that led to today's upheaval. If it were not for the QF incentives of PURPA, it is difficult to imagine how a NUG industry would have developed, and in turn, how a competitive industry would be emerging today.[100] The generation technologies that are driving today's policy revolution had been under development prior to PURPA, but it was the (re)emergence of a NUG industry, beginning with QFs, that provided incentives for them to be adopted and further improved. Without these technological breakthroughs, today we would likely be seeing small PURPA plants augmenting integrated utility systems' generation capacity at best, serving as the butt of jokes at worst.[101] Thus, it was the coupling of public policy *and* technology that allowed for the restructuring we are witnessing today.

And how did this process get set into motion? From the policy end, it was the result of seemingly benign incentives for PURPA plants that were written into the legislation and acted upon by the FERC and state commissions. This is similar to the case of long distance telephone service, where new participants entered when the FCC offered competition in limited segments of AT&T's turf. These cases demonstrate that the incentives created by policy decisions, even small ones, can lead to large changes.

11.7.1.2 The Future "Streams" in the Revised Garbage Can Model

Taking Peter Temin's claim that "history does not repeat itself, but it does have echoes,"[102] we can gain insights from studying the flows of the various streams in the industry's evolution. (See Figure 3.3) Based upon the PURPA experience, we posit that the creation of a constituency with interests other than maintaining the status quo transmission structure (such as partial Nutcos) could add a significant new current to the politics stream. We also

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[99]While in retrospect, PURPA clearly undercut these natural monopoly assumptions, it is not evident that this implication was understood at the time. Likewise, today we see proposals that assume that transmission is a natural monopoly; however, in Section 11.6 and in the remainder of Section 11.7, we see how decisions being made today are undercutting the transmission natural monopoly assumption.

[100]Or at least as quickly as it has. One could imagine a scenario where mavericks such as Virginia Power might have seen opportunities as a result of price differentials *between* utilities. However, attempting to restructure the industry from within would have required the breaking of gentlemen's agreements without forces on the outside to encourage it.

[101]Some of the PURPA plants that fit under the small power plant definition utilize esoteric technology and produce power much more expensively than current market rates. For examples see: "Engineer's Ice Plant Helps Power County;" Salkpukas, April 1995; and "Carter-Era Law Keeps Electricity Prices Up In Spite of Surplus."

[102]Temin, 1994.

posit that a new current could eventually develop in the "problem" stream if a deregulation proposal were to include incentives for new transmission companies (partial Nutcos) to employ innovative technologies,[103] specifically, if these new technologies would enable Nutcos to provide less expensive transmission service (than traditional utility transmission service). The events set in motion by having a new competitive constituency and incentives for new technologies should be self-reinforcing, since competition has spurred innovation in other industries[104] and technology can be used for competitive advantage.[105] The policy-making window opening and stream coupling[106] that could result, could lead to another cycle of deregulation and technological innovation, which could make complete NUTS feasible.

In contrast, if competitive new constituents are not created, utilities not facing competition have disincentives to develop or adopt innovations that would lead to the premature obsolescence of high fixed-cost network technologies. Furthermore, without new technologies, new entrants would have no basis for competitive advantage. As a result, in such a case we expect that there would be no new constituents in the politics stream and no new price-differentials in the problem stream that could be coupled, and consequently cause another restructuring.

11.7.1.3 Guiding Policy Objective for Complete NUTS Creation

Another implication of the PURPA case is that a guiding policy objective should be to create a situation where a policy-making "window" could be opened in the event that complete NUTS would make sense. While we have identified some reasons why complete NUTS might be beneficial, the desirability of their development is not conclusive. Furthermore, we cannot predict what other developments might make complete NUTS beneficial. The technological changes necessary for them to become economically feasible could easily mean that a "complete NUTS" would bear little resemblance to what it would today. This redefinition of NUTS could, in turn, lead to benefits that are currently hidden. Thus, restructuring proposals should foster opportunities for NUTS development and not preclude their development. Additionally, the general concepts and pathways for fostering NUTS that are discussed in Section 11.7 should not be thought of as definitive pathways

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[103]An interesting coincidence is that in Chapter 7 we saw that there are technological developments in progress, which is somewhat analogous to 1978, when research on combined-cycle gas turbines was leading to progressively more efficient systems. Source: Wunsch, 1978.
[104]For example, see: Knight, 1995; and Gardner and Gilson, 1994.
[105]Porter, 1980, 348.
[106]New constituents in politics stream and price differentials in problem stream.

for establishing NUTS, but as opportunities that would lead to the opening of the policy window should they make economic sense.

11.7.1.4 Partial NUTS as Precursors to Complete NUTS

In a similar vein, a further implication of the PURPA case is that we should not focus on events/decisions that would lead to the immediate creation of complete NUTS, but rather, we should examine ways that partial NUTS could emerge and expand. The incremental nature of technological and political change favors the development of complete NUTS as the climax of a series of partial NUTS stages, rather than a process by which they are created overnight. With this in mind, let us explore some of the pathways by which partial NUTS might develop and eventually lead to the emergence of complete NUTS.

11.7.2 Secondary Markets

Secondary transmission markets and/or congestion contract rights[107] are one potential pathway for NUTS development. William Hogan developed the most elegant secondary markets formulation, the contract network model for transmission rights.[108] This system explicitly provides revenues to build transmission lines -- whether they be built by transmission utilities or "outside" investors (Nutcos).[109] In a similar vein, Mark Lively proposes that a real-time pricing scheme could allow a financier to offer a transmission futures contract. In such a case, "when the expected RTP [real time price] difference [between two points on the grid] grows too large, the financier would invest in a transmission line connecting the two geographic points."[110] Eric Woychik divines what could result when ownership and operation of transmission assets are separated and secondary markets are created.

> If tradable transmission rights and congestion pricing can be market-based, and third parties are allowed to invest, these mechanisms can supplant many of the needs for regulation... Private entities in competition can then develop and can offer other services.[111]

Tabors *et al*[112] envision an even more competitive transmission market -- where firm and non-firm transmission service contracts would be consummated and an active spot market for interruptable transmission service would develop. Transmission companies, aggregators, and generation companies would buy and sell in the interruptable spot market. In all of these scenarios, transmission system finances and operation would be unbundled,

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107 Which could take different forms and have varying degrees of efficiency.

108 See Hogan, 1992; and Hogan, March, 1993.

109 Hogan, March 1993, 27-28; and Hogan, 19 October 1995.

110 Lively, 1994, 31.

111 Woychik, August-September 1995, 79.

112 Tabors, Caramanis and Associates, 1995.

new constituencies would emerge, and sources of transmission service revenue would be created that could be captured by Nutcos. At least parts of the aforementioned industry visions will likely come into being soon. The Mega-NOPR calls for the development of secondary markets for firm transmission service, and the California Final proposal also calls for an undefined system of transmission rights and congestion contracts.

Three types of partial Nuctos could easily emerge in this environment: transmission construction, transmission ownership, and transmission service reseller partial Nutcos.

11.7.3 Utilities Actively Turn to NUTS For Additional Capacity

In the generation segment of the industry, the emergence of IPPs was partially the result of an "almost total abdication by the industry of its traditional role as builders of new capacity"[113] during the period of rate suppression. There are several circumstances that could lead to similar behavior by transmission utilities (i.e. cessation of building new assets or even the sale of existing ones), which would allow a segue for partial Nutcos. Circumstances or strategies of individual utilities that could lead to their partially or completely leaving the transmission business include:

- Problems with transmission siting, financing, permitting, and construction;[114]
- EMF lawsuits;
- Corporate decision that transmission is no longer part of the utility's mission;[115]
- Continuation of the current transition-era disincentives for transmission capacity expansion that are resulting from uncertainties about capital recovery in a restructured industry;[116]
- Requirement, based upon Mega-NOPR common carrier obligations, that a financially weak utility build additional capacity when it lacks the ability to raise capital at a reasonable rate; and
- State commission-encouraged, if not mandated, auctions for transmission capacity expansion.

The transmission capacity auctions could, in turn, stimulate technological progress if they are conducted in a manner that would favor bids employing new technologies. New transmission capacity is not the only type of transmission service provision for which there could be supply auctions; proposals are already being developed for ancillary services provision auctions. Once again, regulatory bodies could attempt to stimulate technological development by tweaking the auction rules to favor new technologies. While attempts to

[113]Navarro, 1995, 350.
[114]Roseman, 1991, 36.
[115]It is doubtful that many utilities would forsake the relatively comfortable world of regulated transmission, but a few might -- perhaps those that are in the upper echelon of generation efficiency.
[116]See Section 9.6.2.4.

stimulate new technologies through these methods may not be economically efficient in the short-term, they may lead to long-term efficiency increases.[117]

11.7.4 Fissure Between Ownership and Operation

The unbundling of transmission ownership from operation has a profound implication for the nature of transmission ownership. In the past, the prerequisites for transmission system ownership were (1) the ability to operate and maintain a transmission system, and (2) the ability to attract the capital necessary to finance its construction. The implication of unbundling these technical and financial prerequisites is that there is no reason that any company or group of investors could not own transmission lines. Thus, transmission line partial Nutcos would be more viable in an ISO environment.

11.7.5 Continued Unbundling of Industry

The current industry restructuring features an unbundling of generation, which was once a natural monopoly, from those functions that are still natural monopolies -- transmission and distribution. In some conceptions of the industry, the latter would also be unbundled into electricity sales (not a natural monopoly) and the monopoly "wires" distribution functions.[118] In other industries, unbundling has been a progressive phenomenon -- functions once considered inseparable become unbundled over time.[119] Given current technologies, some transmission system functions, such as system control, will likely retain natural monopoly characteristics. However, there are some transmission system functions that do not appear have natural monopoly characteristics and therefore could be unbundled from those that do. First, some of the ancillary services are likely unbundleable. Doing so will be more complicated than many in the policy community expect, however. This is a result of the collective goods economic nature and the technical complexity of these services. Improved technologies and theoretical understandings, as well as experience in a competitive market, should make the unbundling of ancillary services a progressive phenomenon, even if few of them are unbundled initially. Second, transmission ownership could be unbundled. Per our previous discussion, this would be facilitated through the creation of ISOs. Third, the ISO could have responsibility for constructing new transmission facilities.

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[117]Note the emphasis on "may." PURPA has caused some successes and some dismal failures. As mentioned in Appendix B.8, significant stranded liability bills have been amassed as the result of pushing PURPA technologies.

[118]For example, see: Wisconsin Public Service Commission, October 1995, 9; and Tabors Caramanis & Associates, 1995.

[119]Gottlieb and Colucci, 1995.

These three types of unbundlings could lead to a "hollowing out" of grid functions, where the transmission "provider" changes from being an integrated transmission utility to a collection of companies providing services that are coordinated by a system operator. We postulate that a transmission system that includes multiple Nutcos would more readily allow for the emergence of competing complete NUTS than would a transmission system that is operated by a vertically-integrated transmission utility with a franchised service territory. We postulate this for several reasons. First, a multiple partial Nutco situation would build technical competencies in multiple players. Second, it would create new political constituencies (partial Nutcos) who could then clamor for a "bigger piece of the action" should new technology make it feasible. Third, a situation where multiple players would be seeking competitive advantage would likely encourage technological development, which could drive further change.

11.7.6 Contestability

Contestability is an economic theory that suggests that a firm behaves as if it were in a perfectly competitive market if entry is credible and imminent should the firm reap super-economic profits, even though it may be a monopolistic or oligopolisitic firm in its market. The theory's proponents claim,

> Contestability theory focuses increased attention upon entry barriers and redefines their character. Economies of scale, for example, have frequently been considered an impediment to entry; contestability analysis shows, however, that they need not permit excessive profits or prices or any other manifestations usually associated with market power, even when scale economies make an industry a natural monopoly or oligopoly. It is the presence of sunk costs rather than economies of scale that is of vital significance for both theory and practice.[120]

When these conditions are met, a market is contestable (in the ideal case it is perfectly contestable) and the need for extensive regulation is significantly reduced, if not eliminated. However, transmission systems have significant sunk costs. As a result, transmission systems, in their present form, are not contestable.

While transmission systems do not meet the conditions of contestability, concepts from contestability theory are still helpful in our analysis. For example, the ideas of Woychik[121] and Tabors *et al*,[122] have contestability underpinnings. In their conceptions of the industry, secondary markets are competitive and create some degree of contestability. Likewise, the California Final proposal contains the option of having the ISO collect

[120] Bailey and Baumol, 1984, 111-112.
[121] Woychik, August-September 1995.
[122] Tabors, Caramanis and Associates, 1995.

congestion fees and use these revenues to build and upgrade transmission facilities in order to prevent market power abuse by transmission utilities. The Chilean power industry already uses contestability -- the transmission utility would be required to interconnect any new lines that would be built by a non-utility. In these cases, contestability is used to circumvent market power problems regarding the construction of new transmission lines that would function on the established transmission system, rather than to contest the operation of existing facilities. Under these scenarios, the development of a transmission construction partial Nutco would only occur once contestability fails to motivate the transmission utility to construct new capacity. However, in the presence of zealous ISO's, disgruntled transmission customers, entrepreneurial would-be Nutcos, or utilities who do not want to wish to build new capacity, this "failure" could easily occur.

11.7.7 Openings Due to Pricing Structure and Cross-Subsidization

Partial NUTS could also develop as a result of customers attempting to bypass a cross-subsidy or other non-economic charge imposed on the transmission system. It has been demonstrated by economic theorists[123] and in practice[124] that the assessment of non-economic fees creates an incentive to bypass the tariffed system.[125] Such a situation entices new entrants to "cream skim," to serve those customers whose marginal service costs are well below the "average cost" or "marginal cost plus" that they would pay under regulated service rates.

While free market advocates might argue that such inefficiencies (cross-subsidies) would not be tolerated in a competitive, restructured electric power industry; political realities indicate otherwise. Restructuring will create winners and losers, and those who perceive that they will lose have a strong incentive to fight the changes or seek remediation.[126] As a result, it is unlikely that deregulation will fully eliminate the current cross-subsidies, and some new ones may be created in the process. Even the Telecommunications Act of 1996, with its sweeping moves toward deregulation, featured some cross-subsidies.[127]

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[123]For example, see Faulhaber, 1975; and Faulhaber and Levinson, 1981.

[124]One interpretation of the cause of the Bell System Break-up was the price structure used by the FCC that subsidized local service by higher long distance rates. Source: Temin, 1987.

[125]Whether the incentive leads to actual bypass depends upon the size of the fee and the availability and cost of the bypass option.

[126]Hyman, 1994, 131.

[127]For example, the current legislation maintains subsidies for rural users, in order to guarantee universal service, despite wireless alternatives. Source: Pearl, 1995; and United States Senate, 1996, S688 (floor speech by Sen. Ernest Hollings).

The potential for NUTS developing because of uneconomic transmission fees has already been recognized. The California Bilateral proposal mentions that collecting a Competitive Transition Charge (CTC) through transmission service tariffs, rather than through a non-bypassable fee, might lead to the development of non-utility transmission.[128] However, the opportunity for bypass via NUTS is less likely than analogous bypass in most industries because of the high sunk costs that would be incurred and the scale economies of transmission systems. (Self-generation would likely be a more economic form of bypass than NUTS.) Nevertheless, bypass is not impossible and a technological breakthrough such as wireless power transmission (WPT) would greatly increase its feasibility.

11.7.8 Elimination of the Natural Monopoly

While it is likely that one or a combination of the previously mentioned policy-based pathways would need to be taken for the development of complete NUTS to occur, these alone would not allow complete NUTS to emerge. The policy pathways would need to be augmented by a reduction or elimination of the natural monopoly characteristics of transmission systems; which, in turn, would require technological innovation. In Chapter 7 we examine three technologies currently under development that could drastically change the nature of electric power systems when used alone or in combination. Let us explore several scenarios for their adoption on transmission systems.

11.7.8.1 FACTS to Mitigate Reduced Economies of Scale of Complete NUTS

Much of the basis for the natural monopoly nature of transmission systems lies in the requirement that generation instantaneously match demand without storage. Consequently, the result of "competing" systems using current technologies would be reduced pool sizes, which would clash with the system's economies of scale. FACTS could mitigate, if not eliminate this problem through their ability to function as "electric valves." With this capability, competitive and independent systems could operate with an interconnect that could be used for emergencies, which would have the effect of pooling their reserve margins. (However, we mention above that such pooling could lead to unfavorable economic externalities.)

The ability to gate lines would also allow competing complete NUTS to have overlapping connections to transmission customers. Conceivably, generators could send some of their power over one complete Nutco's lines and some over another system's lines. Likewise,

[128]Knight, 1995, 89.

load transmission customers (distribution companies, industrial customers, etc.) could receive power from multiple Nutcos simultaneously, or could readily switch from one to the other in order to take advantage of favorable prices.

11.7.8.2 Superconductive Storage

Another revolutionary innovation would be the development of economical storage technologies, such as large-scale superconductive storage devices. These devices would substantially reduce the scale economies of transmission systems (thereby reducing the impediments to complete NUTS development) by internalizing, in the form of stored energy, many of the transmission functions necessary to keep generation and load balanced. In particular, a complete NUTS could use these as the primary source of emergency reserve margins and peak generation capacity.

11.7.8.3 Superconductive Lines and/or Wireless Power Transmission (WPT)

Superconductive transmission lines and WPT could offer opportunities for overcoming the system scale economies barrier to complete NUTS through their ability to "pool" generators over a large geographical area. In the case of superconductive transmission lines, pooling would occur through long-distance physical interconnections that would be free of resistive losses. In the case of WPT, pooling would occur through the ability to send a beam of energy across a long distance in the event that it should be needed. Therefore, a Nutco could be connected to only a small percentage of the generators in any given region yet still achieve scale economies of system operation, reliability, etc., over a large area -- if not the whole country. This would lower the entry barriers for complete Nutcos and would diminish the negative impact of Nutcos in any particular region.

With respect to contestability economic theory, WPT technologies would also eliminate the immobile investment problem that helps to make transmission line service an incontestable market. WPT would allow a Nutco to contest transmission utilities in multiple places simultaneously. Much like airlines have done in the deregulation era, a Nutco could relatively easily withdraw service from those areas where it was unsuccessful in attracting customers, and redeploy its assets (i.e. lasers, antennas, rectennas, etc.) into more successful corridors.[129]

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[129]Sinha, 1986.

11.7.8.4 Economic Realities and Technological Change

The technology innovations and their uses mentioned above illustrate just several possibilities, other technologies or applications could be developed in their stead. Although these technologies and their potential to transform the industry sound exciting, often technological viability can often lead economic viability.[130] New technologies may be able to eliminate some of the technical impediments and drawbacks of complete NUTS; but for them to facilitate the development of complete NUTS, these technologies must do so in a manner that is less expensive than the existing technologies (with their very low variable vis-a-vis fixed costs). As a result, the hurdle of economic viability is likely much higher than the technological viability hurdle. The economic hurdle could be lowered if technological innovations would lead to currently unforeseen benefits that would result from a reconceptualization of electric power systems. For example, if new technologies were able to eliminate or reduce the need for spinning reserves and the amount of transmission losses (which are not included in the O&M costs of transmission), the economic hurdle would be much lower (although still not insignificant).

11.8 WHO MIGHT GO NUTS?

Having now discussed how NUTS could develop, we ask: who would "go NUTS."

11.8.1 Non-Utility Generators (NUGs)

Since the ownership of NUTS by NUGs could lead to operating synergies, NUGs might be first to become Nutcos.[131] For example, if a NUG were to build a new generator in a transmission-constrained area, it could seek mandatory wheeling over existing lines or request the construction of a new transmission line by the local utility. Alternatively, it could view becoming a partial Nutco as a strategic business move -- the NUG could build its own line and gain income from what would have otherwise been an expense. The line construction could also facilitate future planned generation construction by the NUG.

11.8.2 Utilities

Just as some entrepreneurial utilities have built upon their core competencies by creating IPP affiliates,[132] utilities could view partial Nutco affiliates as another rational corporate growth vehicle. Since some ancillary services require capabilities that go beyond operating

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130 Angerman, 1996; and "Please Hold For New Technology."

131 Roseman, 1991.

132 For a description of one of the most entrepreneurial, recent moves by a utility see: "Puget, Duke Discuss Generation Buyout."

a plant for the purpose of producing only megawatts, experienced utilities could have a comparative advantage in providing them. For example, load following ancillary service provision requires that a generator constantly increase and decrease output in order to match load. Similarly, a well run transmission utility could be well positioned to build and maintain new lines in the event of a transmission capacity construction auction.

In order to implement an ancillary services Nutco strategy, a utility's Nutco affiliate could scour the country, purchasing a niche of power plants that may not be the most efficient or least cost, but that are well positioned, either technically or spatially, to serve as ancillary service providers.

11.8.3 Other Related Companies

Companies in related industries such as Bechtel (engineering and construction) and ENRON (natural gas)[133] have been strong new entrants into the generation industry in recent years. These and other similar companies could see synergies in the Nutco business as well. For example, a company that builds transmission lines or supplies new transmission technologies could see operating a Nutco as a way of stimulating demand for its products by its being a captive customer. Natural gas companies could form transmission line Nutcos as alternative "pipelines" for natural gas (that is changed to electricity in highly efficient gas turbines).

11.9 CONCLUSIONS

Non-utility transmission systems could take two general forms: complete NUTS (complete, non-utility transmission systems), and partial NUTS ("transmission" functions on the current grid that would be provided competitively). Complete and partial NUTS have different predicted fates.

The four state-level proposals and the FERC Mega-NOPR expect that partial NUTS will develop in some transmission functions -- especially ancillary services. We anticipate that the number and scope of partial NUTS opportunities will increase beyond what is expected in the proposals as new technologies are developed and experience is gained in a more competitively-based industry. Partial NUTS could provide several benefits, including the potential to move the industry to a higher state of dynamic efficiency by entrepreneurially removing transmission constraints on the macro level (which would likely not occur, or

[133]See, for instance: Southerland, 1996.

would be substantially delayed, in the context of the current utility-owned industry structure).

In contrast, the future of complete NUTS looks dim. All of the restructuring proposals assume that transmission systems are natural monopolies. Furthermore, through their creation of state-wide ISOs (which would combine multiple, smaller control areas), the state-level proposals would extend the most fundamental system natural monopoly characteristic over a larger area. This policy approach appears to be well-founded because the near-term development of complete NUTS is technologically and economically infeasible. Furthermore, consistent with trends in other industries, electric power provision appears to be moving from business structure paradigm of physical integration to one based upon financial integration. Complete NUTS would likely be "selected against" in this evolutionary process.

Although the restructuring proposals and industry trends are moving in a direction away from the development of complete NUTS, it is conceivable that complete NUTS could still emerge. If partial NUTS emerge and transmission service becomes increasingly unbundled, the natural monopoly “transmission system” would be pared back to fewer functions. Competitive Nutcos and technological innovations could lead to a drastic reconstitution of these "pared back" transmission systems. An implication of this is that a "complete NUTS" several decades from now may be entirely different than our current definition of a "complete NUTS." Since we can identify a number of potential benefits to complete NUTS (as we know them today) as well as some transmission technologies that are under development that could make complete NUTS (either as defined now or in the future) technically feasible, it would be prudent to leave the possibility for their development open. We assume that they (both complete NUTS and the technologies) would only develop if their benefits outweigh their detriments. Even if they ultimately are not adopted, leaving the possibility of their development open could stimulate other positive, unintended consequences.

The question now becomes how? On a broad level, the forces of technological and political change should be stimulated and definitely should not be unnecessarily shackled. On the technological level, a goal should be to "sow the seeds" for complete Nutcos by creating a demand for new, revolutionary technologies. A goal for political change should be to guide the industry's evolution in a manner that would allow for the "policy window" to open should economic and technical feasibility for complete NUTS arise. In the generation segment of the industry, this was accomplished by creating political constituencies (QFs). In transmission, partial Nutcos could fill that role.

Looking at the micro-level, we can ask: how could new technologies be stimulated? One option, which would be easier to implement if the ISO were given responsibility for procuring all ancillary services (as opposed to allowing self- or third party-provision), would be to build incentives for the use of new technologies into ancillary service provision auction processes. Similarly, if new transmission capacity is eventually provided through an auction process, the use of innovative transmission technologies could be given (favorable) treatment similar to that of renewable resources in generation capacity auctions.

Another option, which would take an opposite approach, would be to design the industry structure so that as many "potential" partial NUTS functions are in fact provided through competitive mechanisms. This approach assumes that partial Nutcos would develop (or would provide a market for suppliers of) new technologies in order to gain competitive advantage.

In short, while it is highly likely that transmission systems will retain natural monopoly characteristics for at least the next decade if not perpetually, allowing competition in some transmission functions -- through competitive bidding of ancillary services, new transmission construction and ownership, and the creation of secondary markets -- would enhance the potential for the eventual emergence of a complete NUTS industry, and could create a vibrant, and socially beneficial partial Nutco industry. In the process, new technologies and unintended positive outcomes could occur. By making decisions today that would allow, rather than foreclose upon the development of NUTS, policy-makers could allow future generations the benefits of a more efficient system.

Chapter 12
Conclusions

While the laws of supply and demand and the invisible hand are very powerful, they are not more powerful than the laws of physics and can operate efficiently only by accommodating physical realities.[1]

-- *Paul L. Joskow (1996)*

12.1 EVALUATION WITH RESPECT TO THE CRITERIA

This thesis examines five proposals for partially deregulating the electric power industry with respect to their predicted impact on long-term economic efficiency in transmission. Several conclusions emerge from our evaluation.

12.1.1 Evaluation and Ranking of Proposals

We examine two types of proposals: four state-level ones, which seek restructure all industry components within a state, and the March 1995 Federal Energy Regulatory Commission (FERC) Notice of Proposed Rulemaking on Transmission Access (Mega-NOPR), which would open the wholesale power market to full competition and would demarcate the transmission segment of the industry in the formulation of the state-level proposals.[2]

Our evaluation finds some significant problems with the Mega-NOPR. In particular, the transmission pricing structure, although unclear, would appear to lead to inefficiencies caused by its non-reliance on marginal cost pricing principles, its potential for conflicting pricing structures, and its overall incoherence in pricing incentives.

In the California Public Utilities Commission (CPUC) December 1995 decision that selected the foundation for its restructuring efforts, we find that the CPUC chose the most efficient state-level restructuring proposal (California Final) of those examined in this thesis. The second-most efficient proposal appears to be the California POOLCO proposal. We say "appears to be" because of the significant number of important details that are

[1]Joskow, 1996, 69.

[2]Jurisdiction of electric power regulation is split between the states and the FERC. It is believed that the FERC has the authority to regulate all unbundled transmission sales.

absent from it. Depending upon how these details would be settled, the POOLCO proposal could be as efficient as the California Final proposal. On the other hand, it could easily be surpassed by the next most efficient proposal (California Bilateral), which also lacks many important details. The most inefficient proposal is the Wisconsin Plausible Extreme model. While the California Final proposal appears to be the preferable one, we do not find the magnitude by which it is the best choice.[3] This is a significant problem because our criteria only address one of many issues that need to be balanced when restructuring the industry.[4] Therefore, while we establish a rank order, it must be recognized that this ranking is subject to high sensitivity with respect to undetermined proposal details and only represents one piece of a larger puzzle. In short, the thesis affirms the Commission's choice, but does not give it a "ringing endorsement."

But then one might ask, what is the value of this thesis if it can only give relatively fuzzy answers with regard to one part of a larger puzzle? We attempt to answer this question in the remainder of this section and chapter.

12.1.2 Raises Important Issues

This thesis raises issues that are seldom, if ever discussed in the restructuring debate. For example, although our proposal ranking is qualified, we do find that there are important issues regarding economic efficiency in transmission which have at least some "answers." For example, while there are unresolved debates as to what type of transmission pricing structure would strike the best balance between accuracy and functionality,[5] we find that economic principles can be brought to bear on these discussions. Even if the economic principles cannot conclusively determine the "best" method of transmission pricing, they can identify ones that are clearly inferior, and inform decision-makers of trade-offs.

Even more unique to the debate is the discussion of transmission technology dynamics in the thesis. Essentially all debates of issues such as transmission pricing efficiency[6] are premised on the static case. We find, however, that there are benefits in evaluating the situation more dynamically. We find that technological change, an instrumental catalyst in

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[3]This is due to the qualitative nature of our criteria and the lack of details of the "competing" proposals.
[4]For example, if the California Final proposal is only slightly superior to the Bilateral proposal in terms of long-term economic efficiency in transmission, but the latter is far more efficient with respect to generation, it could easily be argued that the Bilateral proposal would be the one that should be chosen.
[5]Especially in light of the understanding that there may not yet exist a completely self-consistent pricing framework.
[6]Which themselves are at the fringe of the larger deregulation debate.

the current deregulation activity, is worth considering so that a more efficient future industry could be created, if technologies and economics would allow. Consideration of these issues now is important so that technological change can be stimulated, or at least not inhibited by the restructuring decisions that are being made today.

12.1.3 The Details Are More Important Than the Framework

A corollary to evaluating the five specific proposals is to determine whether any of the restructuring frameworks[7] are superior or inferior to the others with respect to their impact on long-term economic efficiency in transmission. Yet, one of the most important reasons for the superiority of the California Final proposal is that it is more "complete" than the others. The California POOLCO and California Bilateral proposals have some efficient characteristics, however, their overall impact on efficiency is rather unclear because they do not outline important determinants of efficiency, such as transmission pricing structures. As a result, while we find that the California Final proposal -- a "hybrid" of a Pool-based and bilateral-based structure -- is preferable to the California POOLCO and Bilateral proposals, we cannot reasonably conclude that the hybrid framework is inherently better than a pool- or bilateral-based framework. Likewise, the state-wide or regional transmission company framework may not be less efficient than the other frameworks; it just happened that the specific transmission pricing rules proposed in the Wisconsin Plausible Extreme model make the specific model inferior to the others. Put in other terms, our analysis does not identify a framework that is clearly superior or one that is clearly inferior. At the same time, it also does not preclude the existence of either of these.

This brings us to another important finding -- the details of the proposals appear to have a larger impact on efficiency than the frameworks of which they are a part. This finding is corroborated by our analysis of the FERC Mega-NOPR. There too, we find that its efficiency problems have their roots in its specific details rather than in the proposal's framework itself. The most significant implication of this discussion is that the decisions made when the details are developed -- mundane or boring to the masses as they may be -- are predicted to be more important in determining the efficiency of transmission in the restructured industry than the decision whether to adopt a pool- or bilateral-based framework.

[7]In Chapter 10 we make the following differentiation between a proposal and a framework: A framework is here considered to a broad category of deregulation proposals, such as: pool-based, bilateral contract-based, single transmission company-based model. Within each framework would be a number of specific proposals. For instance, POOLCO was just one of several pool-based proposals (many of which were quite similar) that were bantered about in California. Similarly, PG&E proposed a bilateral model which would be within the same framework as the California bilateral model, but differ in details.

From this discussion we can make two hypotheses. The first is that for a superior framework (if one exists) to produce superior efficiency results, it must be accompanied by optimal details.[8] A second hypothesis is that none of the proposals evaluated in the thesis have the combination of both of these items.

12.1.4 Innovation in Transmission Technology Has Been Ignored

It is distressing to note that only two of the five proposals give even vague mention to the possibility that innovations may occur in transmission technologies, and none of them attempt to consider the implications of technological change or explicitly foster innovation. In short, all five proposals are built upon the static case and assume that it will continue *ad infinitum*. When one considers that throughout its history the electric power industry has been marked by significant technological innovation, and that the current restructuring is the result of improvements in generation and information technologies, this disregard of transmission technology innovation is most unfortunate. However, this neglect is not unexpected. Little attention has been paid to the transmission system in the rush to deregulate the generation segment of the industry,[9] and much of that attention has revolved around transmission access. Even by those, such as Prof. William Hogan, who have championed the cause of transmission, there has been a dearth of ideas on how the transmission system might evolve with new technologies.

The danger of this neglect of consideration for technological development is that it could stymie the development of technologies and institutional structures that would be more efficient in the long term. These changes, if allowed to occur, could extend beyond the transmission segment and impact the way that the whole industry is structured.

12.2 Keeping The Opportunity Open For The Next Industry Restructuring

The industry restructuring that is now occurring is largely the result of the overturning of an assumption that the electric power industry has been built upon for the past half-century: economies of scale in generation. This upheaval has resulted from changes in technology, but also was possible only through policy changes. The new industry structure that is

[8]This discussion is of course simplistic, in the sense that the way that a proposal is implemented plays a significant role -- probably equal to if not greater than design -- in the ultimate success of a proposal. While implementation can be facilitated by the design of a proposal, it cannot be mandated. Source: Jones, 1984, 164-195.

[9]Although the POOLCO vs. Bilateral debate in California did bring more attention to the grid than had been paid to it previously.

being developed is based upon a fundamental assumption of natural monopoly characteristics of transmission. This almost inherently suggests that transmission should be operated as a regulated, common carrier monopoly *ad infinitum.* In the short term, this is an appropriate strategy -- transmission systems appear to have several significant natural monopoly characteristics. Furthermore, it may also be that this is the appropriate long-term structure of the industry.

But then again, it may not. We explore three technologies, currently under development, that hold the potential to overturn this fundamental assumption. If, in fact, these become developed to their full potential, we could see another major restructuring of the industry, should that lead to an even more efficient structure -- but only if the policy framework would allow it. While it is nearly impossible to envision what "transmission" would look like in several decades, or what the potential benefits of non-utility transmission systems (NUTS) might be, we must remember that when PURPA became law 17 years ago, few envisioned the way that the industry has evolved. Given that the undercutting of the transmission natural monopoly assumption would be as drastic as the one we are currently experiencing and realizing the potential benefits of the current restructuring, it would be desirable not to foreclose upon that possibility.

The caveat, however, is that these technologies would need to be allowed to be developed and adopted in order for this to occur. The development of technology is evolutionary and path dependent.[10] So too is the path of public policy development.[11] Currently, there are some clear technology and policy barriers to the adoption of these technologies. With transmission being provided by a natural monopoly, and given the long service life of transmission assets, there is good reason to believe that barriers to the wide-spread adoption of new transmission technologies exist. This is somewhat akin to the alleged situation of the generation industry prior to the passage of PURPA. The bottom line is that while these technologies may have the potential for fundamental restructuring, their development may be stunted and transforming capabilities muted without a policy structure that encourages their development or allows them to transform the industry. Thus, by neglecting technological change in transmission -- both the potential for it to occur and the impact that it would have on industry structure -- today's decision-makers could be dooming future generations to a sub-optimal electric power industry structure and technology base.

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[10]Arthur, 1990.
[11]Kingdon, 1995, 222-225.

One way to prevent foreclosure of another industry restructuring -- which would possibly result in complete NUTS -- is to make transmission service (broadly defined) as competitive as possible in the new industry structure. This could be done through the use of an independent system operator structure and through active competitive solicitations for ancillary services and new transmission capacity. While the ISO is a "framework" level issue, the competitive solicitation issues are at the "proposal," or even the "detail" levels.

12.3 CONCLUSIONS IN PERSPECTIVE

The focus of this thesis is to evaluate a representative sub-set of the proposals for electric power industry deregulation based upon their economic efficiency in the transmission segment. There are several considerations that one must be mindful of when performing such an analysis.

12.3.1 Other Issues and Industry Segments are Important

One consideration is that transmission is just one component of a highly-interconnected, larger industry and economic efficiency is just one of many criteria that can be used to evaluate a proposal. While transmission plays a vital role in the functioning of electric power systems, its direct economic impact (in terms of costs) is relatively minor -- those who are looking for significant monetary savings from restructuring will not find them in the transmission industry segment. Therefore, a case could be made that economic efficiency in transmission should not take priority over other efficiency issues, such as economic efficiency in generation. In fact, such a view is difficult to refute.

There are also measures other than economic efficiency by which the proposals could be evaluated. For example, we see in our evaluation of the Wisconsin Plausible Extreme model that a state's desire to create an electric power export business, or conversely, to minimize the in-state environmental damage of electric plants, could be reasons for operating the grid in an economically inefficient manner.

The bottom line is that our analysis should be valuable to bring to the table in the proposal formulation process, but it should be balanced with other metrics.

12.3.2 The Role of Politics

Politics will play an important role in the deregulation process. While rational, comprehensive analysis should be used as a tool in the process, policy-making gravitates toward incrementalism, or in the words of Lindbloom, "the science of muddling through"[12] -- especially in our American, democratic society. Political compromise (rather than reliance on pure technical analysis) is the vehicle by which decisions are made. This is especially true in the electric power restructuring, since powerful interests are being brought to bear on a $200 billion per year industry. Furthermore, there is no "right" way to handle many of the issues (although there are likely many "wrong" ones), such as how to distribute the cost of transmission fixed costs, and perhaps, according to the findings of the thesis, even the selection of the overall framework. As such, these decisions can only be made politically.

12.3.3 Uncertainty of the Predicted Future

Our evaluation inherently assumes that we can predict the impact that the proposals would have on economic efficiency by testing them with our criteria. This is an assumption that is not entirely correct, for a couple of reasons.

12.3.3.1 Evolutionary Nature of Systems

First, the new industry structures created in the current wave of deregulation will not remain constant, instead, they will continue to evolve over time. New technologies, personalities, and external events enter the picture and fundamentally change the predicted conditions. We witness this in the case of PURPA and in the stories of the natural gas and telephone industry deregulations. Evolution should not be surprising in the case of natural gas, where the process of deregulation itself was very incremental and occurred over a long time period. In the case of the telephone industry, however, the major deregulation event (AT&T's divestiture) literally changed the industry overnight. While one could postulate that an abrupt change to a new system (such as the divestiture of AT&T) would lead to predictable outcomes, that has not been the case. Peter Temin reminds us, "do not expect to predict accurately any large change in industry structure. Despite the extensive regulatory proceedings, legislative hearings, litigation, and academic analysis, the MFJ did not have anything like the effects anticipated for it at the time."[13]

12.3.3.2 Errors in Criteria and Analysis

Beyond this natural tendency for the industry to evolve in unexpected ways, we must recognize that our criteria and analysis are also subject to error. Therefore, while we have

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[12]Lindbloom, 1959.
[13]Temin, 1994, 13.

indicated the anticipated impact of these proposals, these evaluations are subject to uncertainty.

12.3.3.3 Implications

Two implications arise from these uncertainties. First, it is important to create an industry structure that can accommodate and encourage beneficial change. For example, we specifically call for leaving the opportunity open for the development of non-utility transmission systems. Second, what we bring to the policy-making table should be recognized for what it is, an educated and well-thought through prediction of what might occur. Although it contains significant uncertainties, it can be used to assist a political process. As Eric Hirst and Brendan Kirby note,

> Ultimately, decisions on industry structure will be largely judgmental, based on incomplete facts and analysis. But we have an obligation to ensure that decision makers understand well the consequences of the choices they face, based on the *best* incomplete data and imperfect analysis we are able to provide them.[14]

In the end, regardless of all the lessons that can be learned from other industries and economic principles, the way that proposals are implemented, technological developments, and other external impacts will play an important role in their outcomes.

12.4 GOVERNANCE IMPLICATIONS

In California, the Executive and Legislative branches have openly desired an opportunity to review the CPUC's restructuring decisions in order to adequately consider the Commission's conclusions and "react with any legislative initiatives deemed in the public's interest."[15] In many, if not all other, states the Legislature has some degree of oversight of the process because it will eventually be asked to amend the Public Utilities Code in order to incorporate the changes necessary for restructuring. Depending upon the specifics of each state's Code -- how much independent authority is given a utility commission -- the Legislature would have varying degrees of necessary actions to take. In some cases this explicit oversight might be only to change the funding process for public purpose programs. In other cases, the Legislature may be required to make more fundamental changes in the authority granted to the Commission.

A significant implication for policy-making comes from our finding that the details are more important than the overall deregulation framework in determining the efficiency of the resulting proposals with respect to transmission. While we have witnessed that this is the

[14] Hirst and Kirby, 1995,18.
[15] CPUC, May 1995, 1.

case for the transmission segment of the industry, it does not take a large leap of faith to conclude, or at least responsibly speculate, that this is true beyond the narrow case we have studied, and that overall, the broad frameworks differ relatively little in their impacts on efficiency. Instead the meaningful efficiency differences occur in the proposal details which are likely to be "fleshed out" over time. This implies that the rules set by the non-elected staff and commissioners (and perhaps the unintended consequences of the decisions) are as, if not more important than any actions which may take place by democratically elected representatives.[16] For example, although the California Legislature has essentially demanded final say on the restructuring matter, its input on the matter will be merely window-dressing unless it is willing to retain oversight of the process beyond 29 March 1996 (the date by which the CPUC requested the legislative provide input on its December decision).

12.5 POLICY RECOMMENDATIONS

Based upon the conclusions presented in this chapter we make the following policy recommendations.

12.5.1 Oversight of the Details

Since proposal details can have a larger impact on the economic efficiency impact of the proposals than the proposal selection decision ithself, it is important that the same standard of public participation that has characterized the debate in the vanguard states[17] continue once the broader market structure is set and the policy-making process moves into the more arcane and tedious detail development stage. It is heartening to note that the California Final proposal already includes many of these important details (which were absent from previous ones); nevertheless, it too is incomplete and the decisions that have yet to be made are significant. It is further encouraging to observe that both the California Public Utilities Commission and the Wisconsin Public Service Commission explicitly mention their intent to keep their respective legislatures and the public included in the proposal development process.

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[16]The rush of lobbyists to the Federal Communications Commission, which is responsible for writing the rules for the Telecommunciations Act of 1996, would appear to corroborate this assertion. Source: "The FCC Is Besieged As It Rewrties Rules In Telecommunications."

[17]For example, the California Public Utilities Commission mentioned in the California Final Proposal and Commissioner Knight mentioned in the California Bilateral Proposal that the restructuring debate was marked by an unprecedented level of public participation. Sources: CPUC, D.95-12-063, 1, 18-24; and Knight, 1995, 13-16, 117. The Wisconsin Public Service Commission has emphasized the important give-and-take that must occur between the regulatory body; the Legislature, and the stakeholders in the process. See: Wisconsin Public Service Commission, 22 February 1996.

12.5.2 Improve the Mega-NOPR

Currently the FERC is in the latter stages of the rulemaking process for stranded cost recovery and transmission access which was started by the Mega-NOPR.[18] Based upon our findings, we strongly recommend that the FERC reexamine the proposition and the consequences of non-marginal cost transmission pricing and the potential inefficiencies inherent in its utility-by-utility transmission tariff structure.

12.5.3 Policies That Could Stimulate the Development of NUTS

We reaffirm the conventional wisdom that an attempt to create a fully competitive transmission service market is currently infeasible, since some transmission functions appear to have natural monopoly characteristics. However, we identify some technologies that, over time, could transform this integrative part of the industry and could eventually lead to another radical restructuring of the industry. While these technologies may never bear fruit, either economically or technologically, it seems prudent to at least leave the opportunity open for them to do so. Five policies which should not be detrimental to short-term economic efficiency and might stimulate transmission technology innovation and adoption are identified.

12.5.3.1 The Use of An Independent System Operator

The establishment of an ISO-based industry structure would allow for many of the subsequent recommendations because of its unbundling of transmission services and its establishment of a "fairer" competitive system. For example, if the system operator were to be connected to those who provide unbundled transmission services, a relatively large opportunity for self-dealing would be created . This is especially true for some of the ancillary services, where their ability to be provided in a competitive fashion is dubious. Thus, it is fair to assume that for regulatory reasons, competition would be overly constrained in a non-ISO environment, and with it, the prospects for innovation would diminish.

12.5.3.2 Competitive Provision of Ancillary Services

To the extent that it is possible to unbundle ancillary services in a manner which retains system technical reliability, it would be desirable to have the ancillary services provided through a competitive process.

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[18] Actually, the process was started 9 months earlier with the filing of a NOPR on stranded cost recovery, which was revised in the Mega-NOPR.

12.5.3.3 Competitive Provision of New Transmission Capacity

Following the passage of PURPA, non-utilities began to provide new generation capacity. If an ISO takes over system operation, there is little reason that non-utilities could not construct new transmission capacity as well. One possible mechanism would be to follow the PURPA model of the late-1980s -- have competitive solicitations for new transmission capacity when it is needed.

12.5.3.4 Secondary Markets for Transmission Capacity

Another policy recommendation is to create a secondary market for transmission capacity. While these secondary markets could take varying forms, it would be desirable to create them in a manner that would provide consistent and efficient incentives for grid use and construction. Secondary markets would reduce the market power of transmission owners and would create additional pressures for more efficient options, should they become available.

12.5.3.5 Stimuli for Transmission Technology Development

In the case of PURPA we see how an attempt to stimulate new generation technologies through the requirement of mandatory purchases from alternative energy and cogeneration plants led to a drastic change in the economies of scale of generation and, in turn, of the industry structure. A similar approach could be tried with respect to new transmission technologies -- those who would construct transmission capacity using new technologies (perhaps only when the capacity is needed) would receive priority in some sort of a bidding process, and/or would earn subsidized rates of return. It should be noted, though, that this set-aside/subsidy approach was characteristic of the general regulatory climate of the era which was ending at about the time of PURPA, and is in many ways antithetical to the prevailing regulatory winds. The use of "alternative transmission facilities" would also be more technically complicated than "alternative energy generators," because generators are relatively[19] isolated entities at the end of network "spokes," whereas transmission lines connect the nodes in a complicated, integrated system. Thus, this idea is presented here as more of a policy option, than an actual recommendation.

While it is impossible to know whether, or in what form it might occur, these policies may lead to a future restructuring of the industry.[20] As such, they would represent a responsible policy approach by giving future generations the opportunity for even more efficient electric power systems.

[19]Although there is still an intimate connection with the entire system.
[20]And provide another generation of MIT students with exciting thesis topics.

Afterword

The electricity industry is extremely important to the country, and is a principal example of a complicated mix of diverse private enterprises and complex government responsibilities. The success of electricity market restructuring is important; the problems are challenging, and the process is fascinating.[1]

AF.1 INTRODUCTION

Two regulatory events occurred while final revisions were being made to this thesis which have significant implications for it. A decision was made to not alter the thesis to incorporate them, because doing so would require significant additional revisions. Instead, this afterword briefly examines these regulatory developments and the implications they might have for the thesis' findings.

AF.2 FERC ORDERS 888 AND 889 AND RM96-11

On 24 April 1996, the Federal Energy Regulatory Commission (FERC) issued a 1000 page[2] final rulemaking on transmission access and wholesale stranded costs. This rulemaking consisted of two decisions (Orders 888 and 889) and a new Notice of Proposed Rulemaking (RM96-11).

AF.2.1 The FERC's Actions

AF.2.1.1 Order 888

The purpose of Order 888, "Promoting Wholesale Competition Through Open Access Non-discriminatory Transmission Services By Public Utilities" is to place the open access principles of the Energy Policy Act of 1992 (as interpreted by the FERC) into a functional federal regulation. Let us now briefly discuss several of the Order's provisions which are particularly applicable to this thesis.

AF.2.1.1.1 Open Access

In a reiteration of the policy proposed in the Mega-NOPR, Order 888 requires "open access transmission by all public utilities that own, operate, or control interstate transmission."[3]

[1]Hogan, November 1995, 50-51.
[2]Source: "U.S. Rule Order Electric Concerns To Widen Access."
[3]FERC, 24 April 1996a, 5.

Furthermore, transmission utilities "must file tariffs that offer others the same transmission services they provide themselves, under comparable terms and conditions. Utilities must take transmission service for their own wholesale transactions under the terms and conditions of the tariff."[4] These open access requirements also apply to power pools and other coordination agreements among utilities. The Order outlines a *pro forma* tariff that describes minimum terms and conditions for network and point-to-point transmission service. Transmission rates, however, will be proposed by the utilities (and approved by the FERC).

AF.2.1.1.2 Ancillary services

One of the significant policy changes from the Mega-NOPR is Order 888's redefinition of ancillary services (see Table AF.1).

Table AF.1: Comparison of Mega-NOPR and Order 888 Ancillary Services

Mega-NOPR Ancillary Services	Order 888 Ancillary Services
• Reactive power/voltage control	• Reactive supply and voltage control from generation sources service
• Loss compensation	• Regulation and frequency response service
• Scheduling and dispatching	• Scheduling, system control, and dispatch
• Load following	• Operating reserve -- spinning reserve service
• System protection	• Operating reserve -- supplemental reserve service
• Energy Imbalance	• Energy imbalance service

Sources: FERC, April 1995; and FERC, 24 April 1996, Press Release, 13.

Not only were the ancillary services redefined, the provisions for uniform ancillary service rates were also scrapped. Instead, Order 888 requires each utility to submit its own pricing schedule for ancillary services which allows it to recover its costs.

AF.2.1.1.3 Independent system operators

Another important change from the Mega-NOPR is Order 888's treatment of independent system operators (ISOs). The Mega-NOPR was premised upon the continuation of utility ownership and operation of transmission systems (although it would have mandated functional unbundling), and was silent on the issue of ISOs. In contrast, while Order 888 is designed for the base case of continued utility ownership and operation of transmission systems (it does not require utilities to turn their assets over to an ISO), it provides a

[4] Ibid.

flexible enough structure to handle ISOs. Furthermore, it establishes eleven principles for ISOs which it intends to use in its review of ISO applications.[5]

AF.2.1.1.4 Stranded investment

The Order retains the stranded investment recovery provisions of the Mega-NOPR. In short, the states are responsible for policy- and decision-making with respect to stranded investments caused by retail wheeling (unless a state commission explicitly lacks the authority to do so), and the FERC will have domain over stranded investments that result from wholesale wheeling.

AF.2.1.1.5 Jurisdiction

Order 888 maintains that the FERC has "exclusive jurisdiction over the rates, terms and conditions of unbundled retail transmission in interstate commerce up to the point of local distribution."[6] The FERC will defer to the states on the determination of which specific assets are transmission and which are distribution, provided that the state commissions employ the seven "local distribution indicators" put forward in the Order,[7] and another relevant facts in their decision-making.

AF.2.1.1.6 Capacity Reservation and Reassignment

Transmission customers are eligible to reserve as much capacity as they wish (unless the Commission determines that they are hoarding it), and will not lose their rights to firm capacity simply because they do not use it. Furthermore, they are eligible to reassign (sell) point-to-point transmission service (but not network service) to other users directly, provided that the assignees meet the transmission provider's reliability criteria. However, a price cap will be placed on transmission resales, which will be the highest of:

- the original price charged to the transmission customer (assignor);
- the transmission provider's maximum stated rate in effect at the time of reassignment; and
- the assignor's own opportunity costs capped at the cost of expansion.

This is a change from current practice (and the Mega-NOPR's proposed reassignment caps) of capping the reassignment price at the price originally paid to the public utility (i.e. the first bullet). The Order also provides guidelines for prioritizing and curtailing service reservations.

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[5]For a listing of the eleven principles, see: FERC, 24 April 1996a, 22-23.
[6]FERC, 24 April 1996a, 4.
[7]For the listing of the seven indicators, see: FERC, 24 April 1996a, 18.

AF.2.1.1.7 Functional Unbundling

Order 888 retains the Mega-NOPR's requirement that utilities functionally unbundle their transmission and power marketing functions -- it does not require divestiture of any assets.

AF.2.1.2 Order 889

Order 889, "Open Access Same-Time Information System and Standards of Conduct," establishes the rules and standards of conduct for open access same-time information systems (OASIS), which the FERC had previously referred to as real-time information networks (RINs). The Order requires utilities to post transmission tariffs via OASIS mechanisms and establishes standards of conduct to prevent functionally unbundled, utility-affiliated power marketing employees from receiving preferential transmission-related information. It also sets the OASIS's information reporting standards and proposes a timetable for further refinement of the standards.

AF.2.1.3 Notice of Proposed Rulemaking (NOPR) RM96-11

In Notice of Proposed Rulemaking (NOPR) RM96-11, the Commission seeks an immediate revisitation of some of the pricing issues that are included in Order 888. The FERC is doing this because, "in analyzing the comments in the Open Access proceeding, it became apparent that a single service open access tariff might better accommodate competitive changes occurring in the industry..."[8] The FERC is going through this two-stage process -- Rule 888 followed by RM96-11 -- because the intent of the former was to require nondiscriminatory access to the transmission network, not to modify traditional tariff design.[9] Thus, with the open access issue resolved, at least in terms of policy-making, the FERC is turning its attention to new pricing mechanisms.

The heart of the proposal is to replace "network" and "point-to-point" transmission service tariffs with a capacity reservation tariff (CRT) that would accommodate the needs inherent in both of the two former tariffs. Network tariffs are use-based while point-to-point tariffs are reservation-based. The FERC has been persuaded that having two bases for pricing is an inferior option (to a single basis) and believes that a reservation-based tariff would better meet the needs of the emerging competitive industry. As the Commission explains, "Under the CRT, all transmission customers would specify the amount of power to be received and delivered at multiple receipt and delivery points, and would have substantial flexibility in

[8]FERC, 24 April 1996b, 4.
[9]Ibid.

rearranging these receipt and delivery points."[10] The FERC lists many advantages to having a reservation-based CRT mechanism, including:[11]

- Compatibility with the OASIS requirement that customers know how much capacity is available;
- Placement of all jurisdictional customers on the same basis;
- A more flexible framework for accommodating industry innovations and pricing reforms;
- Difficulty of reselling load-based service and the potential consequence of having a shallow transmission market;
- Potential inability to unbundle load-based transmission from generation;
- Facilitation of transmission planning; and
- Ease of placing retail transmission functions on the same footing as wholesale customers.

From the perspective of transmission users, the CRT would work as follows:

> Under the CRT... all firm transmission users ... would nominate and reserve transmission capacity; they would nominate and reserve firm rights to receive specific amounts of power at specific grid PORs [points of receipts] and to deliver specific amount of power at specific grid PODs [points of delivery].[12]

The transmission utility would then be required to set aside sufficient capacity to allow for any potential combinations of power receipts and deliveries between the PODs and PORs. In short, the FERC would establish a tariff framework based upon power injections and withdrawals, and would allow utilities, ISOs, etc. to develop consistent, non-discriminatory pricing mechanisms and capacity definition protocols that account for power flows. However, the FERC would not abdicate its authority over those tariffs -- the Commission would still approve them (it also proposes 15 CRT principles) -- but the framework would be more flexible since the tariff proposals would not have to include both network and point-to-point services, nor meet their particular definitions.

AF.2.2 Impact on Efficiency

AF.2.2.1 Evaluation With Respect to Our Recommendations

In this thesis we make several policy recommendations that are relevant to the FERC's orders. We now evaluate the conformance of the FERC's orders with several of our recommendations.

AF.2.2.1.1 The FERC should reexamine the proposition and the consequences of non-marginal cost transmission pricing.

The FERC takes a step in this direction through its CRT proposal. However, this would be an indirect step, in the sense that it anticipates that innovative pricing mechanisms would

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[10] Ibid., 5-6.
[11] Summarized from: FERC, 24 April 1996b, 8-16.
[12] FERC, 24 April 1996b, 16.

be facilitated by the CRT (which could include marginal cost pricing), but it does not call for a marginal cost-based CRT.

AF.2.2.1.2 The FERC should reexamine the potential inefficiencies inherent in its utility-by-utility transmission tariff structure.

The orders and the rulemaking would continue the practice of utility-by-utility transmission pricing structures.

AF.2.2.1.3 An ISO-based industry structure should be developed

Although Order 888 does not require utilities to turn control of their transmission systems over to ISOs, it makes the formation of ISOs much easier. The FERC does this by altering several of the Mega-NOPR's provisions to accommodate ISOs and by promulgating principles for ISOs. Given the evolutionary nature of industry restructuring, this may well be the most prudent action for the FERC to take at this juncture, since mandating the creation of ISOs would be a highly disruptive event in the transition process. Instead, the FERC's decision to eliminate unnecessary restrictions and to let the other industry participants debate the details should lead to more efficient structures, and could well result in an ISO-based industry structure.[13]

AF.2.2.1.4 A secondary market for transmission capacity should be created.

The change in the price cap of transmission capacity reassignment should have a significant impact on the likelihood of an active secondary transmission capacity market developing. Some trading of capacity would have likely occurred under the Mega-NOPR suggested price cap, but it would have been limited to excess capacity sold to minimize losses. Under the price cap of Order 888, a profit-driven market could develop.

AF.2.2.2 Evaluation With Respect to Our Criteria

Our intent is not to undertake a comprehensive or definitive evaluation of the FERC's orders based upon our criteria, but rather, to highlight several of the issues of particular importance to the discussion of this thesis.

While the FERC's redefinition of ancillary services and new pricing mechanisms for their provision may still be open to some debate within the industry as it tries to determine more precise technical definitions of ancillary services, the new definitions would appear to be a move in the right direction. Furthermore, allowing the utilities to file their individual tariffs should help ensure that an adequate "amount" of ancillary services are provided, and could

[13]For a discussion of the trend toward ISOs, see "The Midwest ISO: The Next Generation."

lead to prices that more accurately reflect the marginal cost of their provision. On the other hand, there is an efficiency risk of allowing utilities to propose the prices -- at least in the context of the near-term industry structure of continued ownership and operation of transmission systems by utilities (which is Order 888 base case scenario). In the Order's industry paradigm, the transmission utility, in its role as system operator, would determine the amount of ancillary services necessary by each customer (which is necessary since ancillary services are largely collective/public goods). The transmission utility would also provide most of the ancillary services -- some, because the FERC deems them technically best provided by the system operators, others due to a "shallow supply" market for ancillary service provision (at least in the short run). Furthermore, many of the ancillary services are generation-based. As such, they are part of a joint production process (with competitive megawatts generation),[14] but would be a "guaranteed" stream of income. The effect of these factors could be to give utilities an incentive to "over-provide" and over-price ancillary services. To some extent the problem is intractable to cost-of-service regulation, and demonstrates the benefits of ancillary services partial NUTS, especially in generation-based services.

The CRT framework should more readily allow for the use of new, innovative pricing mechanisms as they are developed, since they would not have to fit into the "boxes" of point-to-point and network service.

AF.2.2.3 Other Issue

It is interesting to note, especially in light of our finding that technological change in transmission has been ignored frequently by policy-makers, that the FERC lists "technological innovation" as one of the other "non-quantifiable benefits" that are expected to result from the Orders.[15]

One potential efficiency problem with the CRT proposal is its suggested oversight of overuse (i.e. a transmission customer exceeding its CRT) penalties. The proposal appears to fail our criterion of having regulatory oversight be performed by a body able to regulate with a system perspective since the proposal delegates the assessment of overuse penalties to the states. Given that future, innovative pricing mechanisms (such as multiple-path, flow sensitive pricing schemes) would likely cover multi-state areas, and that such penalties

[14]And, in terms of accounting, the FERC ruled that all production costs would be credited toward the cost of generation because of the difficulties in separating them and the relative insignificance of the ancillary service provision cost. Source: FERC, 10 May 1996a.

[15]FERC, 24 April 1996a, 6.

are the mechanisms that would "entice" market participants into purchasing an efficient amount of CRT quantity, we suggest that the FERC reconsider ceding penalty-setting authority to the states.

While the FERC's proposal of the CRT appears to be a move toward increasing efficiency, much work yet remains on the issue. At this juncture, issues regarding the definition of CRT capacity,[16] tariff structure, and cost allocations are all open questions. The challenge for the FERC, and those who give the Commission policy and technical input, is to answer these questions in a manner that creates a useful tariff structure in the transition era, while allowing the CRT to serve as an effective basis for continuing improvements in tariff efficiency in the long-term.

AF.2.3 Impact on NUTS

We now briefly examine the potential impact of the FERC's orders on the development of non-utility transmission systems (NUTS).

AF.2.3.1 Order 888

The change in the transmission reassignment price cap provisions (between the Mega-NOPR and Order 888) should have a significant impact on stimulating secondary markets for transmission services. The ability to reassign (sell) transmission service for a higher price than it is purchased for should encourage entities to acquire capacity reservations with the intent of selling them at a profit. Thus, transmission resale partial Nutcos would be likely to develop.

AF.2.3.2 Notice of Proposed Rulemaking (NOPR) RM96-11

The CRT proposal contains several principles that have implications for NUTS. The first is that CRTs would offer "standardized transmission products and services."[17] This is significant because, in the presence of reassignment rights (which is another principle), it would offer transmission customers a good that could be resold. Furthermore, because of the increased flexibility (over point-to-point service) that is created by having capacity based upon an array of injection and withdrawal points, rather than pairings of specific transaction points (and perhaps even a contract path), a transmission service reseller partial Nutco could presumably balance the needs of numerous customers simultaneously.

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[16]The concept of "transmission capacity" itself is not well defined. See: Ilić *et al*, August 1996.
[17]FERC, 24 April 1996b, 23.

Another relevant principle regards opportunity cost pricing, which would facilitate mechanisms such as congestion contracts, which, as we describe in Chapter 11, could create incentives and resources for non-utility transmission line construction.

AF.3 CALIFORNIA

On 29 April 1996, the three major California utilities -- Pacific Gas and Electric, Edison International (Southern California Edison), and Enova (San Diego Gas and Electric) -- made three joint filings with the FERC:

- to create an independent system operator (ISO);
- to create a power exchange (PX) for the California ISO grid; and
- to determine boundaries between transmission and distribution.

This was done in order to meet the California Final Proposal's deadline for these issues. The content of the filings was developed through the Western Power Exchange (WEPEX), an organization consisting of a variety of stakeholders in the process, including the three utilities. The proposal was significant because, as the *New York Times*' Agis Salpukas noted, "It would mark the first time that a state's utilities directly competed with other producers in a vast region and yielded control of their transmission systems."[18]

AF.3.1 Independent System Operator[19]

The first filing would establish an ISO, which would be a non-profit, public benefit California corporation. The filing proposes extensive details regarding ISO governance, functions, pricing, and operating protocols. It also specifies which transmission system operations are in the domain of the ISO, and which would be performed by the transmission owners (TOs). In particular,[20]

- The ISO would administer tariffs;
- The ISO would have sole authority to direct the operation of all facilities under its control that affect the reliability of the transmission system. TOs would be responsible for carrying out the ISO's orders regarding physical operation of the system (i.e. TOs are responsible for opening/closing circuits at the request of the ISO, analogous to a generating plant's control room receiving dispatch order from the system operator);
- The ISO would approve requests (from TOs) to take transmission equipment out of service; and
- The ISO would set priorities for restoring transmission facilities after an emergency.

The ISO would not own or build transmission facilities.

[18]Salpukas, April 1996.
[19]The content for this section comes from: Pacific Gas and Electric *et al*, 29 April 1996a; and Western Power Exchange, 29 April 1996.
[20]Summarized from: Pacific Gas and Electric *et al*, 29 April 1996a, 14-17.

AF.3.2 Power Exchange

The second filing would establish the Power Exchange (PX), which would be a non-profit, public benefit California corporation. The PX would "establish a competitive spot market for electric power through a day-ahead and an hour-ahead auction of generation and demand bids using transparent rules and protocols."[21] The filing lays out the power exchange's responsibilities, governance, bidding rules, and bid evaluation procedures.

AF.3.3 Transmission Pricing and Ancillary Services

Embedded in the ISO filing are a transmission pricing scheme and an ancillary services definition and pricing proposal. The non-ancillary services transmission pricing mechanism would include three parts:

- An access charge, which would be designed to cover the transmission owner's revenue requirements or embedded costs. Transmission customers who withdraw power from the grid would be assessed this charge as a fixed rate at their interface with the ISO grid;
- A usage charge that is paid by parties who use paths between congestion management zones; and
- A transmission losses charge, based upon the marginal impact of each grid user.

The congestion management zones mentioned above are regions in the state where congestion is not expected to occur. Thus, they would be designed around more highly congested areas in a way that interzonal transactions would be through congested areas. The zone boundaries would be reviewed periodically so that they match the actual congestion on the grid. WEPEX chose this congestion pricing mechanism, as opposed to more complicated ones, because it promotes efficiency while minimizing the number of different prices that customers see and simplifying administration.

In addition, a transmission congestion contract (TCC) scheme, which is still under development, would be used. This scheme would provide contract holders with revenue streams from congested situations that could be used to construct new capacity. It would also provide those who are paying congestion charges with an incentive to construct new transmission capacity.

There would be two processes for constructing new capacity: economically-driven and reliability-driven. The former would be signaled through the congestion fees, while the latter would be the result of load growth or other events that might impair reliability absent additional capacity.

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[21] Western Power Exchange, 29 April 1996.

The ISO filing goes into great detail in defining[22] the ancillary services and the process through which they would be provided.[23] The ISO would contract out, through a competitive process, the ancillary services that it would make available to transmission customers. A daily auction would be the mechanism used for many of the services. Others, such as reactive power support and black start, would be provided to the ISO through longer (perhaps annual) contracts. Transmission customers would have the option of procuring those ancillary services which can be unbundled from the ISO or a third party, or self-producing them.

AF.3.4 Evaluation of Filings With Respect to the Thesis's Recommendations

AF.3.4.1 To The Extent That It Is Possible To Unbundle Ancillary Services In A Manner Which Retains System Technical Reliability, It Would Be Desirable To Have The Ancillary Services Provided Through A Competitive Process.

The filings would appear to meet this criterion. Careful examination was given to each ancillary service in terms of definition, ability to be unbundled, and mechanisms through which it could be provided competitively.

AF.3.4.2 An ISO-Based Industry Structure Should Be Developed

Per the California Final proposal, the filings are premised upon an ISO-based industry structure.

AF.3.4.3 A Secondary Market For Transmission Capacity Should Be Created.

The filing states that the transmission congestion contracts (although they are not fully developed) will designed in a manner so that they can be traded.

AF.3.5 Impact on NUTS

The further resolution of details (vis-a-vis the final order) regarding the ISO and PX which is embodied in the filings has several implications for the potential development of NUTS.

The ISO filing's provisions that many of ancillary services be provided competitively to the ISO through a daily auction would lead to the emergence of "ISO-supplying ancillary service partial Nutcos." Furthermore, the filing's explicit call for self-provision and third party provision of unbundleable ancillary services would facilitate the emergence of third party ancillary services partial Nutcos.

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[22]Pacific Gas and Electric *et al*, 29 April 1996a, 51-55.
[23]Pacific Gas and Electric *et al*, 29 April 1996a, Appendix D.

The ISO filing's provisions that new capacity could be signaled by congestion contracts or congestion fees could lead to the development of transmission ownership partial Nutcos. However, the filing's statement that "the owner of the transmission system to be expanded has the ultimate obligation to build,"[24] and other similar ones might be construed to prevent non-utility transmission construction. Also, the provisions that transmission owners would be also responsible for physical operation of the transmission system would tend to reduce, at least slightly, the likelihood of transmission partial Nutcos since investors would also need to have (or hire) experience in physically running transmission assets. However, due to the significant staff reductions that are occurring in the utility industry, one would assume that hiring the necessary expertise would not be difficult, and therefore, the continued bundling of ownership and operation is likely a 2nd or 3rd order deterrent to transmission operation Nutcos.

AF.4 CONCLUSIONS

Based upon our cursory review of the FERC's final orders on transmission access and the WEPEX's filings on the transmission system in a restructured California electric power industry, it appears that the industry is moving in a direction that would promote long-term economic efficiency in transmission and which could immediately spawn partial Nutcos, with the potential for more non-utility functions in the long-term.

These proposals also demonstrate how quickly major changes are occurring in the industry, and have not been the only recent occurrences of note. On 1 May 1996, New Hampshire began its first-in-the-nation retail wheeling experiment,[25] and the Massachusetts Department of Public Utilities (DPU) issued its own Restructuring Proposal, which proposes a basic industry structure for the Commonwealth and will now be subject to public comment.[26] (This is analogous to the May 1995 CPUC decision.) This proposal, if adopted, could have an interesting implication. The DPU's proposal, at the macro level, appears to be very similar to the California Final proposal as it is based upon a hybrid framework. Several months ago this would have been surprising, since the conventional wisdom had been that the New England electric power industry would be based upon a bilateral framework. It will be interesting to see whether this signals a rapid convergence to one industry restructuring framework. While this would make the aggregate national process much more simple, the structure homogeneity would negate the benefits of having

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[24]Ibid., 111.
[25]Source: "DPU Details Plan to Spur Competition to Cut Power Rates," 72.
[26]Massachusetts Department of Public Utilities, 1 May 1996.

multiple "real time" regulatory "experiments" as the industry moves through its transition state.

APPENDICES

Appendix A
Principles of Deregulation Proposals

Electricity production is possibly the only just in time commodity -- it is consumed virtually as it is produced.[1]

-- Charles G. Stalon and Eric C. Woychik (1995)

A.1 FERC MEGA-NOPR GOALS[2]

- Facilitate competitive wholesale electric power markets;
- Prevent unduly discriminatory practices in transmission access; and
- Address transition costs associated with open transmission access.

A.2 CPUC "BLUE BOOK" FUNDAMENTALS FOR VISION OF INDUSTRY[3]

- California's consumers gradually enjoy direct access to generation suppliers, marketers, brokers and other service providers in the competitive market for energy services;
- All of California's consumers have a reasonable and fair opportunity to enjoy the benefits of an increasingly competitive electric services industry;
- California's consumers enjoy direct access to the most efficient, environmentally sound electric services infrastructure available;
- Competitive electric services make a significant contribution to growth, productivity, competitiveness, and job creation throughout the state's economy; and
- All Californians enjoy universal access to a basic and affordable package of electric services which reflects and keeps pace with innovation taking place in the broader, competitive market for electric services.

A.3 CALIFORNIA POOLCO PROPOSAL OBJECTIVES[4]

- Reduce the price California consumers pay for electric services;
- Where competition exists, or can be fostered, replace command and control regulation with the discipline of the market; in the absence of competition, supplant traditional cost-of-service regulation with alternatives better focused on performance;
- Benefit all customer classes ;
- Continue electric service that is safe, reliable, environmentally sensitive and available to all customers;
- Retain safety standards;
- Improve the environment and encourage diversity of energy sources; and
- Honor past commitments, do not compromise the financial integrity of utilities, and continue to provide utilities with a reasonable opportunity to earn a fair profit.

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[1]Stalon and Woychik, February 1995, 9.
[2]FERC, April 1995, 17663-17664.
[3]CPUC, 20 April 1994, 12.
[4]CPUC, 24 May 1995, 3-4.

A.4 CALIFORNIA DIRECT ACCESS PROPOSAL GOALS AND COMMITMENTS[5]

- Deliver safe, reliable and reasonably priced electric service;
- Maintain universal service;
- Maintain the utilities' reasonable opportunity to earn a return on investment;
- Continue public purpose, environmental, and resource investment programs, as guided by the California Legislature;
- Lower rates for California consumers;
- Foster innovation;
- Encourage entrepreneurship;
- Foster economic growth and development; and
- Improve California's competitiveness in the global market and with neighboring states.

A.5 CALIFORNIA MEMORANDUM OF UNDERSTANDING PRINCIPLES[6]

- Support the rapid development of a vigorous competitive market in the supply of generation services;
- Promote the efficient utilization of the region's generation and transmission capacity;
- Provide comparable access to and obligations to pay for transmission and network support services;
- Avoid cost shifting between customer classes and among California's distribution utilities;
- Preserve the benefits of low-cost power imports for California customers;
- Minimize transactions costs; and
- Give all customers the opportunity to share in the benefits of competition.

A.6 CALIFORNIA "FINAL" DECISION GOALS[7]

- To offer customers greater choice in their purchases of energy services;
- To allow competition for traditional monopoly services to flourish where conditions are ripe;
- To replace CPUC rate-of-return oversight of industry segments that are not subject to competitive pressures with performance-based ratemaking;
- To reduce the price California customers pay for electricity;
- To continue to deliver safe, reliable, and environmentally sensitive energy services;
- To maintain universal, nondiscriminatory availability of electric services to all California citizens;
- To maintain the financial integrity of the utilities and provide them with a reasonable opportunity to earn a fair return on their investments;
- To continue to further the public good, as perceived by the Legislature and this Commission, by improving the environment, encouraging the diversity of energy sources, and maintaining a variety of important public purpose programs.

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[5] Knight, 1995, Executive Summary Page 4.
[6] Southern California Edison, 1995, 2-3.
[7] CPUC, D.95-12-063, 201-202.

A.7 WISCONSIN OVERARCHING RESTRUCTURING PRINCIPLES[8]

Principles	Implications for Transmission
(1) To create a system that sends accurate price signals to customers resulting in the most economically efficient use of the resource.	Would likely lead to a switch to unbundled and marginal cost pricing.
(2) To create a system which maximizes, within the public interest, the number and diversity of service offerings to customers.	Move to allow competition in some transmission services would be supported.
(3) To create a system in which providers maximize economic efficiency and environmental stewardship.	No clear ones.

A.8 RHODE ISLAND COLLABORATIVE INTERDEPENDENT PRINCIPLES[9]

- Reliable and safe electric service should be maintained;
- Fairness and consistency in transition to new industry and beyond should occur;
- All customer classes should benefit;
- Existing commitments should be honored;
- Utilities should recover legitimate and verifiable stranded costs;
- Near-term rate relief should be provided;
- Electric services should be unbundled;
- Customer choice should exist at the retail level;
- A spot market for electricity should be developed;
- Regulators should streamline administrative processes;
- The New England Power Pool (NEPOOL) should be reformed;
- Deregulation should lead to improved cumulative generation emissions;
- Cost-effective DSM programs should be retained through a non-bypassable, non-discriminatory charge;
- Fuel and technology diversity should be financially supported;
- Electricity service should be provided to all customers;
- Performance-based regulation should be used in parts of the industry that cannot be deregulated; and
- The new industry structure should allow for entities that can attract capital at a reasonable cost.

A.9 MASSACHUSETTS ROUNDTABLE INTERDEPENDENT PRINCIPLES[10]

- Reliable and safe electric service should be maintained, with customers determining the degree of firmness of service that they desire;
- Fairness and consistency in transition to new industry and beyond should occur;
- All customer classes should benefit;
- Contractual rights and obligations should be enforced;
- Utilities should have a reasonable opportunity to recover net, nonmitigatable, strandable costs;
- Near-term rate relief should be provided;
- Electric services should be unbundled;
- Customer choice should exist at the retail level;
- A spot market for electricity should be developed;

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[8]Wisconsin Public Service Commission, July 1995, 3-4.
[9]Electric Industry Restructuring Collaborative, 1995,
[10]Electric Industry Restructuring Roundtable, 1995.

- Regulators should streamline administrative processes;
- The New England Power Pool (NEPOOL) should be reformed;
- Deregulation should lead to improved cumulative generation emissions;
- Cost-effective DSM programs should be retained through a non-bypassable, non-discriminatory charge;
- Fuel and technology diversity should be financially supported;
- Electricity service should be provided to all customers;
- Performance-based regulation should be used in parts of the industry that cannot be deregulated;
- The new industry structure should allow for entities that can attract capital at a reasonable cost; and
- Restructuring should occur through consensus and settlements, as opposed to litigation, whenever possible.

A.10 MASSACHUSETTS DEPARTMENT OF PUBLIC UTILITIES NOTICE OF INQUIRY OBJECTIVES[11]

- Reduce electricity costs over time for all customer classes;
- Develop an efficient industry structure and regulatory framework that minimizes long-term costs and maximizes service reliability;
- Improve the ability for Massachusetts industries to compete nationally and internationally;
- Enhance choices for Massachusetts electricity consumers; and
- Preserve society's ability to pursue other important public policy goals (low-income consumer protection, energy efficiency, environmental protection, energy security, fuel diversity, and research and development).

A.11 ELCON PRINCIPLES FOR ACHIEVING COMPETITIVE, EFFICIENT, AND EQUITABLE RETAIL ELECTRICITY MARKETS[12]

Principles	*Implications for Transmission*
(1) Market forces can do a better job than any government or regulatory agency in determining prices for a commodity such as electricity.	Transmission functions that are not natural monopolies should be opened to competitive forces.
(2) Laws and regulations which restrict the development of competitive electricity markets should be rescinded or amended. The need for burdensome regulation will be reduced where competitive electricity markets are allowed to flourish.	Careful examination should occur to see if there are any transmission functions that could be made competitive.
(3) The benefits from competition will never fully materialize unless and until there is competition in both wholesale and retail electricity markets. But not all retail services are natural monopolies, and therefore, they should not be regulated as such.	New, generation-independent institutions should be developed to provide system control and coordination services.

[11]Massachusetts Department of Public Utilities, 1995, 1-3.
[12]Electricity Consumers Resource Council, 1994.

(4) The owners and operators of transmission and distribution facilities, and the providers of coordination and system control services, should be required to provide access to those facilities and services to any buyer or seller on a non-discriminatory, common-carrier basis.	a. Transmission and coordination system service should be provided on a nondiscriminatory basis. b. Ownership and use of the facilities should be separated, at least functionally. c. "Obligation to serve" --> "obligation to provide direct access." d. Transmission (and distribution) "capacity trading" should be allowed.
(5) Rates for the use of transmission and distribution facilities should reflect the cost of providing the service. If the facility is a natural monopoly, those rates should be based on actual costs and the services provided on a nondiscriminatory and comparable basis to all users.	a. Cost of service pricing for transmission and distribution. b. Comparable and unbundled rates. c. Ability to "repackage" bundled services.
(6) Resource planning is not a natural monopoly. The types and market shares of generation and end-user technologies that would be supplied in wholesale and retail markets should be decided in the marketplace.	Transmission capacity should be signaled by pricing mechanisms.
(7) Legitimate and verifiable transition costs that develop as a result of competition should be recovered by an equitable split among ratepayers, shareholders and taxpayers. The costs of assets that were uneconomical in the existing regulatory regime are not transition costs.	
(8) The potential for transition costs should not be used as an excuse to prevent or delay the onset of a competitive electricity market.	

Appendix B
The Electric Power Industry: From Competition to Regulation and Back

> *If power generation is the heartbeat of power supply, transmission is its primary circulatory system, an equal partner that integrates a utility's generation with its load centers... The heart of a power supply system must have a properly functioning circulatory system.*[1]
>
> *-- American Electric Power (1991)*

B.1 INTRODUCTION

The current structure of the electric power industry is the result of a complex set of interactions between electric utilities and the government that have occurred over the past century. In order to make efficient restructuring decisions for this highly regulated industry, it is important to understand how the industry has evolved into its present form and the distortions that have been created by its regulatory structure. Technological development has also played an important role in the industry's evolution. In this appendix we explore how the industry's history has been driven by a combination of politics and significant technological innovation. We do this because these same forces must be harnessed in order to create a restructured industry that is efficient in the long-run.

B.2 VERTICALLY INTEGRATED MONOPOLY TAKES SHAPE

B.2.1 Edison and Westinghouse

B.2.1.1 The Industry's Birth at the Pearl Street Station

The electric power industry was born on 4 September 1882, when Thomas Edison began operation of the Pearl Street Station in Lower Manhattan. Power flowed a short distance from the station to a carefully selected group of customers: the financial brain trust of Wall Street.[2] Edison's Pearl Street and subsequent systems generated and transmitted direct current (DC) power. Following Edison's success at Pearl Street, the electric power industry quickly began to grow as generators sprouted up across the country.

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[1]American Electric Power, 1991, 7, 12.
[2]Flavin and Lenssen, 1995, 44.

B.2.1.2 The Battle Between Edison and Westinghouse

George Westinghouse, another electricity pioneer, built systems that generated and transmitted alternating current (AC) power.[3] A fierce public battle of the systems quickly ensued between Edison and Westinghouse as they sought to establish their technology as the industry standard.[4] While Edison had garnered the first-mover advantage, a weakness of DC systems was that DC power can only be transmitted efficiently over a relatively short distance. The problems with AC power included a higher health hazard and the initial lack of an AC motor. Attempting to influence the system adoption process using fear tactics, Edison focused his public attacks against Westinghouse systems on AC's health hazards. For this, Edison enlisted the help of Harold Brown and Arthur Kennedy,[5] who performed and publicized experiments during which they electrocuted vicious dogs and large animals, such as cattle.[6] Brown's research group also invented an AC-powered electric chair. When the State of New York was looking for a more humane way to execute criminals in the late 1880s, Edison eagerly proposed that Brown's invention be used and that an execution by electrocution be called being "Westinghoused."[7] Despite Edison's public relations efforts, he eventually lost the battle of the systems once an AC motor was successfully developed.

B.2.2 Early City Systems

The earliest electric power systems were built and operated under the purview of local (city) governance. Municipalities issued permits to electric companies, but in most cases, cities would not grant an exclusive franchise territory to these companies. For example, forty-seven franchises were granted between 1890 and 1905 in the city of Chicago, several of which were city-wide.[8] As a result, the fledgling electricity companies competed vigorously with each other and multiple distribution lines were strung along many streets. In 1910 Delos Wilcox commented, "competition was so thoroughly recognized at the beginning of the industry as proper and possible that in some cases general franchises were granted to all companies desiring to supply electric light and power."[9]

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[3]For a good discussion of the differences between these two, and the properties of electricity, see: Kelly *et al*, 1987, 271-280.
[4]The account in this thesis is based on: Hughes, 1983, 106-139.
[5]Kennedy would later become a Professor of Electrical Engineering at MIT and Harvard.
[6]Brown and Edison gleefully noted that cows are significantly larger than humans.
[7]However, when others suggested that Brown's name be attached to the machine, Brown quickly disappeared from the scene.
[8]Wilcox, 1910, 143.
[9]Wilcox, 1910, 142.

B.2.3 Regulation and Consolidation

In about 1900, people began to see the benefits of a more consolidated industry structure. A leader in this recognition was Chicago's Samuel Insull, who combined engineering, business, and political savvy to rationalize the industry's ownership structure so that firms could take advantage of economies of scale.[10] A 1902 Census Bureau report illuminated some of these scale benefits.

> When plants are brought under one management all the supplies for them are bought in common and consequently are cheaper, the employees are subject to sharper discipline, and the engineering supervision is more careful than in the separate plants; therefore, the plants, as a whole, are likely to be in much better condition and also much more progressive than they were as scattered units...[11]

In order to take advantage of scale economies, cities began to grant electric companies franchise rights, in return, the utilities were subject to economic regulation. Thus, the regulatory compact was born. Consolidation also allowed for the aggregation of power demand into larger loads, which allowed the benefits of increasingly larger, cutting-edge technology plants to be harnessed. As the decade of the 1900s drew on, the increased capabilities of long distance transmission, combined with consolidated ownership structures, transformed the industry into one that was "interurban or state-wide in character and not easily amenable to local control."[12]

B.2.4 Vertical Integration and Natural Monopoly

During this time period, two fundamental characteristics of the industry emerged: vertical integration and natural monopoly.

B.2.4.1 Vertical Integration

Vertical integration is the consolidation of the various steps of a production process into the control of a single firm. Vertical integration has the potential to reduce costs in the following situations:[13]

- Successive stages of production are technologically interdependent;
- Individuals in successive stages can share information more easily within a vertically integrated company;
- The costs of negotiating and enforcing contracts between vertically separate firms are large compared to the costs of decision making within a vertically integrated firm; and
- Substantial monopoly power exists at successive stages, and vertical integration would eliminate the incentive of each separate firm to exercise its monopoly power over the other.

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[10] Hughes, 1983, 201-226.

[11] Cited in Wilcox, 1910, 138-139.

[12] Wilcox, 1910, 142.

[13] FERC, 1989, 83.

The electric power industry[14] has, or at least had, each of these characteristics. The first characteristic was, is, and for the foreseeable future will continue to be true -- the generation, transmission and distribution functions are intimately related in a real-time manner. Because of the coordination inherent in operating an electric power system, the second characteristic (information sharing) was true in the past, although it is being diminished, if not eliminated by rapid advances in information technologies. For similar reasons, the third characteristic (costs of contracts) was also more relevant in the past than today. With regard to the fourth characteristic (monopoly power in successive stages), most people believe that (natural) monopoly power still exists in transmission and distribution. Until recent years, there was also a wide-spread belief that generation was a natural monopoly. For these reasons, the electric power industry took on a vertically-integrated structure.

B.2.4.2 Natural Monopoly

The second fundamental characteristic of the electric power industry has been natural monopoly, which exists when the marginal production cost is always lower than the average production cost for the total quantity demanded by customers.[15] More specifically, a natural monopoly exists when:

- The production of a good exhibits decreasing average costs up to or beyond the quantity demanded by consumers[16] and/or there are overwhelming economies of scope;[17]
- It is possible for one firm to produce the good less expensively than multiple firms;[18] and
- There are high barriers to entry and exit.

Because a industry that is a natural monopoly has the attribute of declining costs per unit output over the quantity demanded, vigorous competition amongst competing suppliers is expected to occur that would continue until only one firm remains in the industry. Once the others have exited, the (natural) monopolist raises prices and restricts output, resulting in economic inefficiency. Starting in the early 1900s, it was believed that natural monopoly economies of scale existed at both the plant and system level in the electric power industry.

A society has three alternatives for organizing a natural monopoly industry: (1) private, unregulated monopoly; (2) private, regulated monopoly; and (3) government ownership. In the first option, the government does not intervene -- it allows the market to dictate the

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[14]Assuming that generation, transmission, and distribution are considered to be three production steps.
[15]Pindyck and Rubinfeld, 1992, 352.
[16]Warren, 1975, 50-51.
[17]Samuelson, 1985, 522.
[18]In economic jargon, the cost of production is sub-additive. Source: Berg and Tschirhart, 1988, 21-23.

number of firms in the industry (which will converge to one) and the prices and terms by which that the firm(s) serve customers. Because the creation of an unregulated monopoly is expected to cause significant allocative efficiency losses, this is not a viable alternative. While almost every other country chose the option of government ownership; the United States has by-in-large chosen the second option -- government regulation of private sector firms. While there are many exceptions -- public power agencies and cooperatives -- investor-owned utilities generate and supply slightly more than three-quarters of America's electricity.[19] Richard Vietor comments on the "distinctively American" choice of market structure in industries such as electricity:

> While nearly all other countries chose to nationalize assets deemed vital to the pubic interest, the United States kept them private -- despite near total economic failure during the Great Depression. The state could intervene, to provide stability and encourage distributive equity, but its authority was bounded by a unique commitment to private property, due process, and the ideal of the market.[20]

This reliance on the private sector was also the result of foresight by turn of the century utility executives, most notably Samuel Insull, who lobbied for such an arrangement.[21]

As these two fundamental principles -- natural monopoly and vertical integration -- were reshaping the electric power industry after the turn of the century, the industry underwent a consolidation, which eventually resulted in the formation of huge utility holding companies.

B.3 HOLDING COMPANIES, PUHCA, AND THE FEDERAL POWER ACT

B.3.1 The Holding Companies and Their Abuses

B.3.1.1 Limitations on State Regulation

By 1930, almost half of America's power production was controlled by the three largest holding companies[22] and nearly three-quarters was produced by the largest eight.[23] Years before, these companies had outgrown local regulation. Even though two-thirds of the states had created regulatory commissions by 1916,[24] these commissions quickly became too small to regulate the ever-aggrandizing utilities. An event that further hampered state regulators was the Supreme Court's landmark 1927 decision, *Rhode Island Public Utilities Commission vs. Attleboro Steam and Electric Co.*, which held that "states could not

[19] Energy Information Administration, November 1993, 3.
[20] Vietor, 1994, 330.
[21] Hughes, 1983, 205-208.
[22] Energy Information Administration, March 1993, 19.
[23] Hyman, 1988, 74.
[24] The first three state commissions were formed in 1907 in Massachusetts, New York, and Wisconsin. Source: Hughes, 1983, 207.

regulate the price of electricity generated in one state and sold in another."[25] This decision left a large regulatory void -- while states were not allowed to regulate interstate transactions, there was no federal agency empowered to do so. Therefore, states were given authority over a relatively small part of an interconnected system. The result was predictable -- the large, multi-state holding companies were able to run circles around the under-staffed, jurisdiction-constrained state regulators through devious practices such as elaborate transfer pricing schemes and corporate pyramids that injured both customers and investors.[26] While the utilities made a lot of money while this structure lasted, in few places was the Depression-era backlash to 1920s-style croynism felt harder than in the utility business.

B.3.1.2 Holding Company Abuses -- The Deck of Cards Collapses

The legislation that ended the holding company era, the Public Utility Holding Companies Act of 1935 (PUHCA), enumerated holding company abuses:

> It is hereby declared that the national public interest, the interest of investors in the securities of holding companies and their subsidiary companies and affiliates, and the interest of consumers of electric energy and natural and manufactured gas, are or may be adversely affected --
> (1) when such investors cannot obtain the information necessary to appraise the financial position or earning power of the issuers, because the absence of uniform standard accounts...
> (2) when subsidiary public-utility companies are subjected to excessive charges ... or enter into transactions in which evils result from an absence of arm's length bargaining or from restraint of free and independent competition...
> (3) when control of subsidiary public-utility companies affects the accounting practices and rates, dividend, and other policies of such companies so as to complicate and obstruct State regulation of such companies...
> (4) when the growth and extension of holding companies bears no relation to economy of management and operation or the integration and coordination of related operating properties; or
> (5) when in any other respect there is lack of economy of management and operation of public-utility companies or lack of efficiency and adequacy of service rendered by such companies, or lack of effective public regulation, or lack of economies in the raising of capital.
>
> When abuses of the character above enumerated become persistent and wide-spread, the holding company becomes an agency which, unless regulated, is injurious to investors, consumers, and the general public; and it is hereby declared to be the policy of this title, in accordance with which policy all the provisions of this title shall be interpreted, to meet the problems and eliminate the evils as enumerated in this section...[27]

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[25]Cited in: Energy Information Administration, March 1993, 21.
[26]Kanner, 1996, 37-38.
[27]PL74-687, 803-804.

B.3.2 PUHCA: The "Death Sentence" Correction

The sternness of the accusations listed in the law were matched with equally stern sanctions; PUHCA numbered the days of the holding companies by mandating,

> the simplification of public utility holding company systems and the elimination therefrom of properties detrimental to the proper function of such [electric power] systems, and to provide as soon as practicable for the elimination of public-utility holding companies except as otherwise expressly provided in this title.[28]

The Act defined a "public utility holding company" as a firm that controls 10% or more of a public utility company's voting shares, or a person that can exercise a "controlling influence over the management or policies of any public utility holding company."[29] An "electric public utility company" is one that "owns or operates facilities used for the generation, transmission, or distribution of electric energy for sale."[30] Exempted from this definition are public utilities that operate within a single state,[31] and entities that produce all of their electric power for their own consumption (i.e. industrial facilities that generate their own power) or for the consumption of in-state affiliates.[32]

Over the ensuing two decades, the Securities and Exchange Commission (SEC) broke up the large holding companies -- in total, 759 utilities were separated from holding company systems.[33] The SEC broke up the holding companies so that the resulting utilities no longer met the definition of "holding company," and therefore were free of PUHCA regulation. However, not all of the holding companies were completely disassembled; approximately a dozen utilities have remained in the category of "registered holding company"[34] and function within the rigid confines of PUHCA.[35] Once the SEC finished disassembling the holding companies, PUHCA faded into the background for about three

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[28]PL74-687, 803.

[29]Ibid., 806.

[30]Ibid., 804.

[31]Not exempt from the definition of a public holding company, but exempt from becoming "registered holding companies" are utilities that only operate in the state they are organized and in states contiguous thereto. Source: Ibid., 804-805.

[32]Ibid.

[33]Hyman, 1988, 83.

[34]Currently, the registered holding companies include: Allegheny Power System, American Electric Power, Central and South West Corp., Eastern Utilities Associates, Entergy, General Public Utilities Corp., New England Electric System, Northeast Utilities, the Southern Company. Sources: Energy Information Administration, January 1993, 617-619; and "SEC Supports Repeal of Law That Restricts Some Big Utilities."

[35]These include: approval by the SEC of all acquisitions; limitations on: board membership, political contributions, transactions within the same company, geographical service territory, and Congressional testimony; close monitoring of contracts; additional reporting requirements by directors; and empowerment of the SEC to become the trustee of the company and/or break it into pieces at the SEC's discretion. Source: PL74-687.

decades (1955-1985).[36] It nevertheless made its mark; PUHCA set the industry's geographical framework by creating an array of relatively small utilities that serve a limited region. PUHCA also essentially precluded outside firms from entering the electric power (and natural gas) business due to the significant limitations it places on the business operations of registered holding companies and the way that holding companies are defined.

B.3.3 The Federal Power Act

In the same piece of legislation as PUHCA was the Federal Power Act (FPA), which has served as the "centerpiece for federal economic regulation of the electric utility industry"[37] ever since. In wake of the 1927 *Attleboro* decision, there was no mechanism for regulating interstate sales of electricity -- the court's decision put this responsibility in the hands of the Federal Government, but there were no federal laws to govern interstate electricity sales nor regulatory agencies to enforce them if any such laws were passed.

The FPA had two major provisions. First, it created the Federal Power Commission (FPC), which was terminated in 1977 and replaced with the Federal Energy Regulatory Commission (FERC), and charged it with federal regulatory oversight of the electric power and gas industries.

Second, the FPA established the basic framework and principles for federal regulation of electric power. The FPA stated,

> It is declared that the business of transmitting and selling electric energy for ultimate distribution to the public is affected with a public interest, and that Federal regulation of matters relating to generation ... and of that part of such business which consists of the transmission of electric energy in interstate commerce and the sale of such energy at wholesale in interstate commerce is ... in the public interest.[38]

The Act defined "electric energy in interstate commerce" as: "electric energy ... transmitted from a state and consumed at any point outside thereof;"[39] and a wholesale sale as: "a sale of electric energy to any person for resale."[40] The Act also established federal regulatory

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[36]However, as is seen in Appendix B.6.4.2, PUHCA became an issue again after 1985 when outside firms wanted to form independent power producers (IPPs). In response, the Energy Policy Act of 1992 reduced the impediments to entering the generation segment of the industry.
[37]Energy Information Administration, March 1993, 21.
[38]PL74-687, 847.
[39]Ibid., 848.
[40]Ibid.

oversight of some electric utility business practices. Furthermore, the Act established several principles to guide federal regulators in their work:[41]

- All rates and charges made, demanded, or received by any public utility for or in connection with the transmission or sale of electricity ... shall be just and reasonable, and any such rate or charge that is not just and reasonable is hereby declared to be unlawful; and
- No public utility shall, with respect to any transmission or sale subject to the jurisdiction of the Commission, (1) make or grant any undue preference or advantage to any person or subject any person to any undue prejudice or disadvantage, or (2) maintain any unreasonable difference in rates, charges, service, facilities, or in any other respect.

The FPA created a bifurcated regulatory structure -- states maintained regulatory authority over the industry's generation and the distribution functions, while federal regulators received jurisdiction over the middle piece, transmission. The Act attempted to draw a line between these two jurisdictions when it stated, "such Federal regulation, however should (sic) extend only to those matters which are not subject to regulation by the States."[42] Unfortunately, separating the purview of state and federal regulators is not simple for both technical and political reasons. As a result, there have been jurisdictional conflicts that even today are not entirely resolved. In several cases, the Supreme Court has broadly interpreted the FPC/FERC's authority, which has been interpreted (although not by all) to mean that the FERC has regulatory authority over all wholesale electricity sales and the pricing of unbundled transmission services.[43] The conflicting jurisdictional claims and policy incongruence that can result from a bifurcated structure are significant obstacles in restructuring the industry.[44]

B.4 THE GOLDEN ERA

The several decades following the enactment of PUHCA and the FPA can aptly be called the golden era of the electric utility industry.[45] During this era, the industry was dominated by vertically-integrated investor-owned utilities (IOUs) that operated monopolies in a rate-of-return regulatory environment. The industry was driven by a series of incremental (yet substantial) improvements in generation, transmission, and distribution technologies. These improvements (which had been occurring since the start of the industry) led to tremendous improvements in productivity. During the period 1899 to 1953, the industry's

[41] Ibid., 851.
[42] PL74-687, 847.
[43] For a discussion of the case law on this see: FERC, April 1995, 17713-17716.
[44] See, for example: Kemezis, 1996; "NARUC-FERC Dialog Spotlights Jurisdiction;" "Moler Rattles Peace Saber at NARUC Meeting;" and "Fessler, Tomasky Have a Friendly Joust on Jurisdiction."
[45] We will refrain from calling it the golden era of the electric power industry, however.

average annual growth of total factor productivity was 5.5%, the highest rate of total factor productivity growth of any major American industry.[46] (See Table B.1) Between 1937

Table B.1: Total Factor Productivity Gains in Selected Industries

Industry	Average Annual Total Factor Productivity Increase (%), 1899-1953
Electric Power	5.5
Manufactured Gas	4.7
Chemicals	2.9
Fabricated Metals	2.6
Railroads	2.6
Electric Machinery	2.2
Natural Gas	2.0
Telephone	2.0
Machinery, non-electric	1.7
Farming	1.1

Source: Kendrick, 1961, 136-137.

and 1948 the annual growth was 6.6%. While productivity growth slowed slightly after 1948,[47] substantial technological and performance improvements continued until about 1970. Consequently, from the birth of the industry until the early 1970s, electric power rates fell in both real *and* nominal terms, while the use of electric power skyrocketed (see Figures 3.1 and 3.2).

B.5 THE ERA ENDS

B.5.1 The Energy Crisis

Figures 3.1 and 3.2 illustrate a significant change that occurred in the 1970s -- the price of electricity stopped declining, and instead began to rise in nominal and real terms. The contrast between the "golden era" and the new era was stark -- in 1963, only three American electric utilities sought rate increases while 114 did in 1975.[48]

The energy crisis was a major cause of electricity rate escalation. When the Arab oil embargo hit in 1973, the electric utility industry was still heavily dependent upon petroleum

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[46] This 1960 study by the National Bureau of Economics examined 33 industries -- from the mining, manufacturing, transportation, agriculture, and utility segments of the economy. Source: Kendrick, 1961, 136-137.

[47] The average electric and gas utility total factor productivity growth was 4.9% between 1948 and 1966. Note, though, that gas utility productivity is added into this figure (we do not know if this inflated or deflated the number.) Source: Kendrick, 1973, 79.

[48] Persons, 1995, 36.

as a fuel source for electric power generation.[49] As a result, skyrocketing oil prices led to significant increases in electricity production costs, which were then passed along[50] to consumers. As Peter Navarro comments, "In the 1970s, an 'energy crisis' turned this industry upside down, sent electricity prices soaring, and all but unraveled a regulatory compact that had delivered blue chip dividends to shareholders and ever decreasing rates to consumers for over fifty years."[51] While it was perhaps the most significant problem facing utilities, the energy crisis was only one of many problems that utilities faced during the 1970s and early 1980s.

B.5.2 Problems Faced by Utilities

Although other underlying problems were not recognized immediately, they started to become obvious in the late 1970s. In 1981, William Berry, then-President and Chief Operating Officer of Virginia Electric Power Company, gave a ground-breaking speech to the Edison Electric Institute which laid out many of the industry's woes.

> You all know only too well what's happened to this industry in the last decade or so: inflation accelerated, interest rates rose, productivity growth slowed, fuel prices rose dramatically, growth in demand stopped, and the cost of meeting environmental and safety regulations soared. For utilities that was truly a devil's brew. Unless conditions change and change soon, our financial infirmities will destroy our ability to provide reliable electric service.[52]

More noteworthy than his diagnosis of the industry's ills was his prognosis for their cure: "I think the answer lies with competition. Electric power generation is no longer a natural monopoly. Let's open electricity generation to competition -- with free entry, no franchises, and no obligation to serve."[53] With these words, Berry became the first president of a major utility to endorse competition in the industry.[54] Let us briefly explore the problems included in his diagnosis, as well as several others.

B.5.2.1 Declining Labor Productivity

Indicative of the industry's problems was its labor productivity,[55] which had grown at an annual rate of 4.1% between 1958 and 1978. However, it reached a peak in 1977, and

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[49]In 1973, slightly more than 35% of electric power was generated from either natural gas (18%) and other petroleum products (17%). In 1994, natural gas alone accounted for 10.0% of generation and other petroleum accounted for 3.1%. Source: Energy Information Administration, July 1995a, 233.

[50]At least in part.

[51]Navarro, 1995, 347.

[52]Berry, 1995, 22.

[53]Ibid., 23.

[54]Ibid.

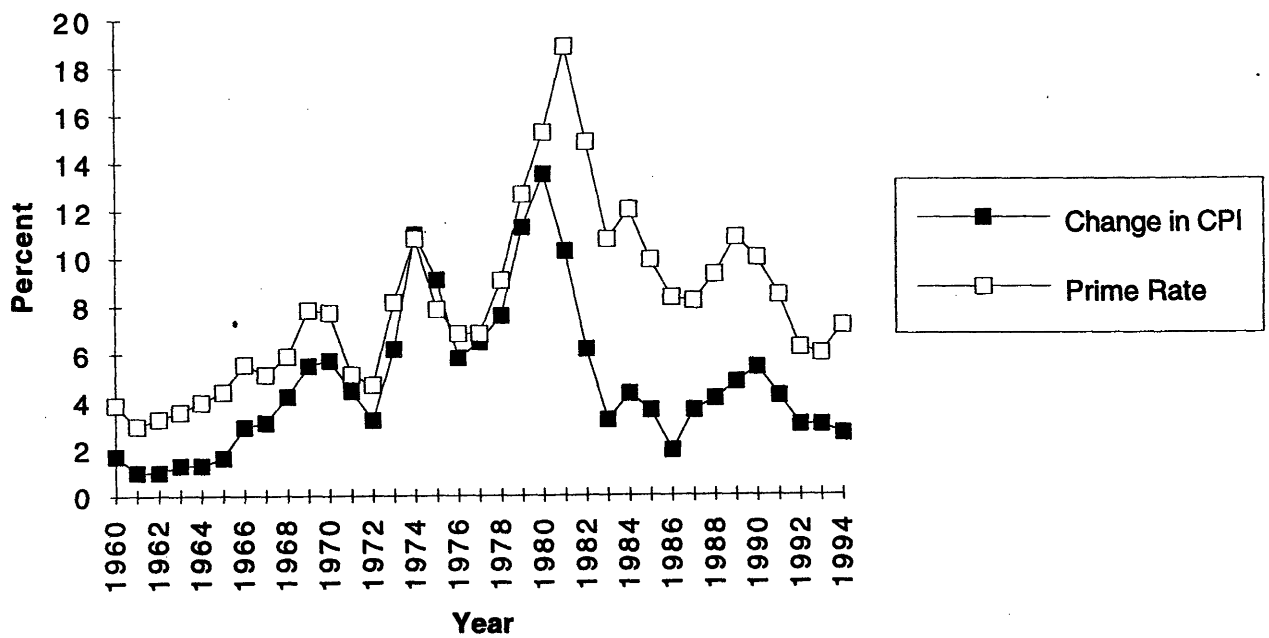
[55]See Figure 4.5 for a graphical presentation of this. It should be noted that in Appendix B.4 we discuss total factor productivity (instead of labor productivity). Hence, and discrepancies in numbers are likely due to the use of closely related, but not identical statistics.

actually *fell* at an average annual rate of (-)1.5% between 1978 and 1983. By 1982, utility industry labor productivity was only 89.3% of what it had been one half decade earlier.[56] It was not until the mid-1980s that productivity began to make measurable gains. By 1994 it stood at 120% of its 1977 level.[57]

B.5.2.2 Over-Building Generation Capacity

Berry mentioned that growth in the demand for electricity stopped; actually, instead of growing at the Post World War II average annual rate of 7.5%, annual growth was a relatively flat 2.5%.[58] This was caused by the higher electricity prices, conservation efforts, and diminished industrial output that occurred in wake of the energy crisis. However, utility planners projected that demand growth would continue into the 1980s at a 7% pace and were slow to adjust to 2.5%, viewing it at first as an aberration rather than the start of a new trend.[59] As a result, utilities continued to build generating plants which had ten year lead times in order to fulfill the projected demand. Not surprisingly, a large generation capacity surplus had developed by the early 1980s.

Figure B.1 Average Prime Interest Rate and Inflation Rate, 1960-1994



Source: United States Bureau of the Census, various years

[56]Bureau of Labor Statistics, 1985, 249.

[57]Bureau of Labor Statistics, 1995.

[58]Calculated from data in Edison Electric Institute, *Statistical Yearbook of the Electric Utility Industry*, various years.

[59]For example, see: Cohen, 1994, 75.

B.5.2.3 Inflation and Interest Rates

Another problem faced by utilities was the high inflation and interest rates of the late 1970s and early 1980s. (See Figure B.1) During this time period, utilities were in the midst of ambitious construction projects of large coal and nuclear plants. The high inflation rates caused the actual costs of these plants to significantly exceed their expected costs. The high interest rates had a similar effect -- the utilities had to raise capital at a higher rate than expected,[60] which made the plants more expensive to build than expected.

Another complication of the high interest rates was that investors required higher returns on their capital investments (i.e. the utilities needed to have higher rates-of-return in order to attract capital), which put an upward pressure on rates. However, since fuel price increases were already placing unprecedented upward pressures on electricity rates, commissions typically dragged their feet in raising the authorized rate-of-return,[61] if they did not outright refuse the increases.

B.5.2.4 Disincentives to Utility Construction

The result was that during the late 1970s and early 1980s, many public utility commissions set electricity rates at a level below what the utilities needed to recover the cost of their capital with a "sufficient" rate-of-return. In some cases, utilities were not allowed an authorized rate-of-return high enough to attract capital. In other cases, commissions broke with tradition[62] and scrutinized the prudence of utility plant construction expenses. When expenses were deemed imprudent, utilities were not allowed to recover part or all of the imprudent capital costs through the rate-base. Nuclear plants, in particular, were subject to prudence reviews. Between 1985 and 1992, electric utilities were forced to write down $22.4 billion of nuclear plant investments.[63]

This era of "rate suppression" led to an era of "capital minimization" on the part of utilities.[64] In contrast to the massive expansion projects started in the late 1970s, utilities began to postpone new plant construction. In some cases, utilities even energetically turned to non-utility PURPA plants to meet their new capacity needs. As Peter Navarro comments,

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[60]Since utilities typically do not begin to recover the costs of plants until they are operating, the construction costs compounded much more rapidly than anticipated.
[61]Joskow, 1989, 158-162.
[62]Between 1945 and 1975 there were less than a dozen prudence reviews. Source: Joskow, 1989, 160.
[63]FERC, April 1995, 17669.
[64]Navarro, 1995, 350.

> In this era of rate suppression, utility executives, in turn responded almost uniformly with a 'strategy of capital minimization.' ... The practical result of this 'rate suppression-capital minimization syndrome' was the almost total abdication by the industry of its traditional role as builders of new capacity.[65]

B.5.2.5 Nuclear Power Plant Debacles

Dozens of nuclear power plants were under construction at the time of the March 1979 accident at the Three Mile Island Nuclear Plant. In response to the accident, the Nuclear Regulatory Commission issued numerous safety regulations that resulted in significant construction delays and expensive modifications to the plants. The financial problems that resulted were literally compounded by the aforementioned high inflation and interest rates of the period. On average, the final cost of a nuclear plant built during this era was approximately 5 times its anticipated cost when construction began.[66] Several plants' costs were an order of magnitude higher than anticipated.[67] While mismanagement and special political situations[68] were responsible for at least some of these cost overruns; the lethal combination of high interest rates, high inflation, and nuclear plant construction modifications and delays created a seemingly uncontrollable chain reaction of red ink and rate increases that mushroomed during the middle and late 1980s.

B.5.2.6 The Limits of Technology

While not fully realized yet at the time of Berry's speech, the industry had reached a plateau with respect to improvements in generation technologies. From the earliest days of the industry, generators that were bigger were better. It was the success at making incremental improvements in generators and pushing the envelope on economies of scale that propelled the industry's golden era. However, thermodynamic limits of the Rankine Cycle were reached by innovations in the 1960s.[69] It was not understood that an asymptote had been reached, however, and a new generation of coal and nuclear plants were developed and constructed in the 1970s that experienced reduced performance to scale.[70] They (large nuclear and supercritical coal plants) were more *complicated* to build and were less reliable (which heightened operating costs).[71] In addition, the nuclear plants had higher capital

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[65]Ibid.
[66]Energy Information Administration, March 1986, 15.
[67]Ibid., 1.
[68]Such as the Seabrook plant which faced massive, relatively effective political resistance.
[69]Yeager, 1994.
[70]Incidentally, many of the plants that contributed to the capacity glut fit into this category.
[71]Joskow and Rose, 1985. Although they were more complicated to build, the coal plants did display decreasing construction costs to scale, but the nuclear plants did not (as is seen in Appendix B.5.2.5).

costs per unit of power output than earlier, smaller plants.[72] In short, the technological developments that had propelled the industry had reached their limits and further improvements could only occur through a new trajectory of technological development.

B.5.2.7 Environmental Regulations

The environmental movement of the late 1960s and 1970s resulted in new environmental regulations for utilities, and in particular, for generating plants. It has been estimated that by 1980, environmental regulations increased the capital cost of new coal plants by at least 20%.[73]

The summation of these problems set the stage for significant changes to occur in the industry. However, the industry was firmly entrenched, and therefore, change was not guaranteed. It took a relatively obscure provision in President Carter's 1978 national energy policy to serve as the catalyst that set in motion the forces for restructuring the industry.

B.6 THE RISE OF NUGS

B.6.1 The Public Utility Regulatory Policies Act of 1978

In 1978, as part of President Carter's extensive national energy policy, Congress passed the Public Utility Regulatory Policies Act of 1978 (PURPA). The act was intended to be an intrusive instrument to force electric utilities into more energy efficient practices. Its main focus was to promote conservation in regulatory policies -- particularly in electric rate structures and inter-utility transmission connections. The only currently relevant provisions of the Act, however, are those regarding small power production and cogeneration, which reside in Section 210 of PURPA.[74] "Although it was little noticed and not controversial during the legislative process, section 210 of PURPA turned out to be the most far-reaching of the NEA's [National Energy Act's] electricity initiatives."[75] Section 210 requires utilities to:

- Purchase electric energy from such facilities ... at rates that shall be just and reasonable to the customers of the electric utility and in the public interest and that shall not discriminate against qualifying cogenerators or small power producers;[76]

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[72]Energy Information Administration, 1986. Although part of this increased cost is the result of the issues covered in Appendix B.5.2.5.
[73]Joskow and Rose, 1985, 24.
[74]Joskow, 1989, 162.
[75]Richardson and Nordhaus, 1995, 66.
[76]Excerpted from: PL95-617, 3144.

- Interconnect their transmission facilities to qualifying cogenerators and small power producers;[77] and
- Sell electric energy to qualifying cogeneration[78] facilities and qualifying small power production facilities.[79]

The cogenerators and small power producers that became eligible for this favored treatment became known as qualifying facilities (QFs).[80]

One intent of PURPA Section 210 was to reverse the long-term trend away from industrial cogeneration (and its energy conservation benefits). In 1950, 15% of total power produced in America was generated by industrial cogenerators. When the Congressional hearings on what became PURPA were held in 1977, this number had fallen to 4%,[81] and bottomed out at 3% in 1979.[82] Industrial facilities which had cogenerated their own power were lured onto utilities' power grids during the 1950s, '60s and early '70s by the low rates that resulted from the continuing improvements in central station generation technology and economies of scale of utility electric power systems -- it had simply become cheaper to buy from the utility than to self-produce power. PURPA also sought to encourage the development of renewable energy technologies.

B.6.2 PURPA's Impact

The impact of PURPA has been significant indeed; in essence PURPA opened the door to the development of an independent electric industry. As one commentator said,

> This initially overlooked section [PURPA's Section 210] all but created the independent power industry, laid the groundwork for the Energy Policy Act's mandate of transmission access, and created the "stranded investment" issue that is frightening segments of the electric generation industry.[83]

Prior to the enactment of PURPA, an unintegrated independent generating sector was essentially nonexistent.[84] Since then, the rise of non-utility generators (NUGs) in the

[77]Excerpted from: PL95-617, 3135.

[78]Cogeneration is the use of waste steam from power production for another use -- the production of electricity using conventional steam plants (coal and nuclear) is approximately 33% efficient, which means that about 2/3 of the energy put into the process is lost through waste steam.

[79]PL95-617, 3144. The law essentially defined qualifying small power producers as renewable energy generators. To "qualify" as a small power producer or cogenerator, a plant needed to meet a number of ownership and technical criteria. For the detailed requirements, see: PL95-617, 3134-3135.

[80]Per the FERC's implementation regulations of PURPA.

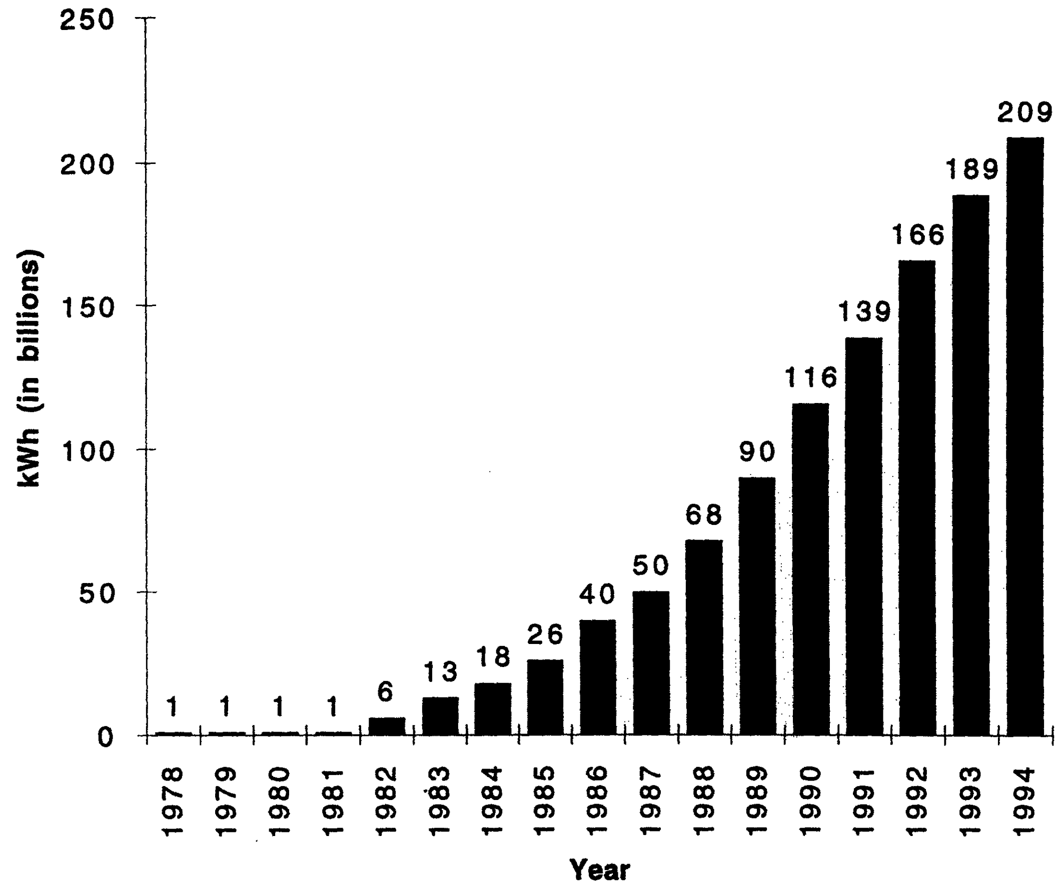
[81]Bardin, 1977, 191.

[82]Energy Information Administration, March 1993, vii.

[83]Wagman, 1994.

[84]Joskow, 1994, 18.

Figure B.2 Purchases by Electric Utilities of Non-Utility Produced Power, 1978-1994



Source: Energy Information Administration, July 1995a, 28.

electric power industry[85] has paralleled the rise of mini-mills in the steel industry.[86] There are many similarities between NUGs and minimills; they are small, lean producers,[87] which employ new technologies[88] and innovative human resource policies[89] to displace the

[85]The emergence of minimills has been described as a rise from the ashes of an industry decimated in the 1980s. Likewise, NUGs have emerged in a once-proud industry humbled in the 1970s and 1980s. They have also arisen from the ashes of President Carter's ill-fated National Energy Policy, which was built upon the assumption that oil prices would continue to escalate through the 1980s and beyond instead of dropping after their 1980 peak.

[86]The story of the rise of minimills is told in Robert W. Crandall and Donald F. Barnett's book, *Up from the Ashes*. See: Crandall and Barnett, 1986. See also: Collins, 1994.

[87]See, for instance: "International Conference on the Future of Industry in Advanced Societies, Conference Report," 6-7.

[88]In both cases, the "new" technologies (electric arc furnaces in steel and gas turbines in electric power) have dramatically reduced the economies of scale of the respective industries.

[89]For examples of the actions taken by specific companies, see: "A Power Producer Is Intent on Giving Power to Its People;" and "International Conference on the Future of Industry in Advanced Societies, Conference Report," 6-7. A good overview of industry practices can be found in: "Compensating Employees."

vertically integrated firms that had dominated their respective industries.[90] Several statistics capture the growth of NUGs. In 1980, only 2% of total generation capacity additions were made by NUGs, while they added 69% of new capacity in 1994.[91] Between 1985 and 1992 non-utility generation increased at an average rate of approximately 17%.[92] (See Figure B.2) Between 1989 and 1993, the number of QF facilities rose from 576 to 1200, with generation capacity rising from 27,429 MW to 47,774 MW.[93] The success of these firms, which is partially indicated by these statistics, led to a rethinking of the electric power industry's fundamental structure. As the FERC notes, "the rapid expansion and performance of the QF industry demonstrated that traditional, vertically integrated public utilities need not be the only sources of reliable power."[94]

By creating a viable NUG industry, PURPA set into motion a series of events that is now transforming the industry. The rest of this chapter, and in many ways, the rest of this thesis is dedicated to examining these events.

B.6.3 Causes of the Changing Paradigm

By catalyzing numerous factors that were in the industry in the 1980s, PURPA was the impetus for changing the industry's paradigm from reliance on vertically-integrated, monopoly utilities to one which allowed for increasing competitive opportunities that have, in the past several years, led to a rethinking of the industry's fundamental structure. Let us explore some of the other factors for change.

B.6.3.1 Utility Problems of the 1970s and Early 1980s

Above we chronicle some significant problems of the electric utility industry in the 1970s, many of which continued in the 1980s. These problems account for some, but not all of the factors that made the industry ripe for restructuring.

B.5.3.2 Excess Capacity

The overbuilding of generation capacity caused by poor utility planning in the 1970s led to excess generating capacity in the 1980s. By 1982, the U.S. aggregate capacity margin, the amount of excess capacity at the demand peak, stood at 33%, up from 21% in 1973.[95]

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[90]For a more complete discussion of this phenomena in these two industries see: Lester, forthcoming.
[91]Tedmon and Roeder, 1995, 61.
[92]Energy Information Administration, June 1994, vii.
[93]FERC, April 1995, 17670.
[94]Ibid.
[95]Energy Information Administration, January 1995, 31.

The presence of excess capacity in the 1980s changed the industry's supply/demand balance. In particular, the glut of high-fixed cost, relatively low incremental cost generation capacity created an incentive for utilities to trade power. At first this situation increased the willingness of utilities to enter into coordination contracts -- short-term agreements to buy and sell power. For example, if one utility had surplus generating capacity and a neighboring utility had higher-cost capacity, they would enter into a coordination contract by which the lower cost utility would produce power for the higher-cost utility and they would split the benefits. Typically, though, these exchanges were short-term in nature. Utilities were responsible for providing (i.e. generating) enough power to serve their customers in the long-run.[96] Thus, the low-cost utility would sell power sold to the higher-cost utility only until its own demand increased sufficiently to eliminate its surplus capacity. At this point in time, because of technological innovations, the "high-cost" utility would often have a new, lower-cost plant on-line. Such transactions had occurred for many years[97] in order to ensure economical and reliable use of their facilities.[98]

The size, duration, and expense of overcapacity in the 1980s made the situation different than before. As mentioned above, instead of aggregate *peak* reserve margins of 20%, they rose to 33%.[99] Since demand growth was much slower than in the past, it would take considerably longer for this overcapacity to be eliminated. Furthermore, the new plants had large capital costs, some of which were being borne by the utilities' shareholders, not the ratepayers, due to unfavorable prudence review decisions. Consequently, as long as a utility was able to sell power for more than its marginal generation cost, it had an incentive to produce and sell it (to other utilities). The increased use of coordination contracts and other exogenous influences eventually led to a shift in industry mind-set. Excess capacity was no longer seen as merely a necessary expense of running a reliable system, but also as a resource from which revenues could be extracted. Coordination contracts became more integral to the business -- rather than only occurring by favorable happenstance, these transactions became part of the business strategy of utilities. Consequently, coordination

[96]Consequently and reciprocally, utilities did not build plants to serve the customers of other utilities and utilities could not plan to be served by others in the long-run.
[97]For a history of coordination activity, see: FERC, 1981, 5-14.
[98]Joskow, 1989, 131.
[99]It should be noted that peak margins of 30% translate into an average load factor of about 60%. Source: Edison Electric Institute, *Statistical Yearbook of the Electric Utility Industry 1994*, 13.

contracts have become longer-term in nature and the sale of excess power has evolved toward the development of a market for wholesale power.

B.6.3.3 Municipal Revolt[100]

Only about 10% of municipal power agencies and cooperatives produce their own power.[101] Instead, they buy it from utilities under wholesale requirements contracts. At one time, these municipal agencies were "captive" customers of their local utilities. Eventually, some municipal agencies began to look beyond their local utility to other sources for their power, but were often blocked from doing so by utilities that refused to wheel the power for them. With time, though, wholesale requirements customers made strides in expanding their ability to "shop" for power. In the 1980s, as the aforementioned new, expensive power plants came on-line,[102] wholesale requirements customers (especially those with high-cost host utilities) had a renewed interest in increasing their wheeling capabilities. As a result, they placed increasing amounts of political pressure on regulatory agencies to open up the transmission grid.

B.6.3.4 Technological Advance

During the 1980s, electric equipment manufacturers and NUGs adopted a new trajectory for generation technology development that led to significant technological advances which turned the economies of scale of electricity generation upside down. When they built new plants, the new NUGs (and utilities to a lesser extent) frequently turned to new technologies, including combined-cycle and advanced gas turbine generators. Quite ironically, PURPA, a law intended to reduce reliance on fossil fuels, was serving as the springboard for a new generation of gas-fueled technologies as many QF cogeneration projects were gas-fueled.

B.6.3.5 Climate of Deregulation

Another cause of the industry's paradigm shift was that the above events occurred during a period of changing political trends. Prior to the late 1970s, the American political climate favored the benefits of government protection over the efficiencies of the market in industries such as electric power. The deregulation of the civil aviation industry, which was sparked by the start of a corresponding shift in intellectual climate about a half-decade earlier, marked a sea-change in this balance. Three days before the Airline Deregulation Act of 1978 was signed into law, President Carter asserted, "I'll predict that within the next

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[100] For more on this topic see: Joskow, 1995.
[101] Pierobon, 1994, 19.
[102] Which, in turn, created large rate differentials between utilities.

few years the Civil Aeronautics Board will find that its existence is no longer needed. Consumers will benefit. Airlines will benefit. Our nation will benefit as well."[103] He was correct on at least three of the points -- (1) the Civil Aeronautics Board, which was retained by the Airline Deregulation Act, went out of business several years later as deregulation occurred even faster and more completely than expected; (2) ticket prices dropped and the number of fliers skyrocketed;[104] and (3) the social welfare gains from deregulation have been calculated to be positive.[105] Only the airline industry, which has undergone massive losses and countless bankruptcies, has seen mixed benefits, although there is some evidence that deregulation did produce a positive welfare gain for the airlines as well.[106]

The success of airline industry deregulation served as a principle- and precedent-setting example for other industries,[107] and catalyzed an intellectual and political climate change that snow-balled with time. Two quotes of Alfred Kahn, a leading figure in the deregulation movement, capture this change. In 1970, he commented on the forces that expand regulatory power and purview; "So long as regulation imposes restraints on competition, it will have to continuously widen and deepen its roots."[108] Yet, in 1994, he described the forces reducing regulatory power; “once you begin to admit competition, it introduces strains and distortions that can typically be resolved only by further deregulation.”[109] Although these quotes may sound inconsistent, they are not. Rather, they are the result of different assumptions. The former assumes the preeminence of the regulatory bureaucracy; that regulation shapes the market. The latter assumes the preeminence of the market; that regulatory structure is shaped to fit market imperfections. While the former view of regulation and competition held sway in the public and government following the Great Depression, the latter has eclipsed it in recent years.[110]

B.6.3.6 Customer Revolt

In the 1980s, American industry and its workers became painfully aware of the rise of global competition. In order to become more competitive, companies looked to save money wherever possible -- including their electric bill, which until then had been largely

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[103]Carter, 1979, 1831.
[104]Gardner and Gilson, 1994,
[105]Winston, 1993, 1284. See also: "On a Wing and a Fare."
[106]Winston, 1993, 1284.
[107]Kingdon, 1984, 200-204.
[108]Kahn, 1971, 28.
[109]Kahn, October 1994, 27.
[110]See Vietor, 1994, 330.

ignored.[111] Large users, through entities such as the Electric Consumers Resource Council (ELCON), began to actively lobby government for policies that would lead to lower industrial electricity rates.

Closely coupled with this was a strong political desire to keep industrial companies competitive. The significant decline of American industry in the 1980s[112] and the job losses that accompanied it made governments at the local and the national level concerned with industrial competitiveness. When high electricity prices were defined by users as a problem that inhibits their industrial competitiveness, governments became interested in taking action.[113] As Peter Navarro comments, "Much of the impetus for restructuring comes from the growing realization among policy makers that both the cost and reliability of electricity play key roles in creating -- and destroying -- competitive advantage in our increasingly global economy."[114] This issue has recently been important in states such as California and Massachusetts, where explicit rationale for their leadership in electric power deregulation proposals has been to lower the (high) cost of electricity in order to make manufacturers in these states more competitive with companies from other states[115] and around the globe.

B.6.4 Limitations of Flexibility in the Existing Structure

In 1990, non-utility generators achieved a significant milestone -- NUGs brought more generating capacity on line than did utilities for the first time.[116] Despite their significant growth, NUGs faced serious impediments to more extensive growth in the early 1990s.

B.6.4.1 Transmission Access

One of these impediments was lack of access to the transmission grid. TOUs could deny non-utilities access to potential customers by denying use of their transmission lines. For example, a TOU could halt a NUG upstart competitor if the NUG was planning to produce power for a wholesale customer of the utility. It became clear that such market power imbalances would not facilitate a truly competitive market. As a result, during the late-1980s, the FERC began to employ transmission policies that facilitated competition; specifically, the FERC required open access to the transmission systems of utilities that

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[111]Tabors and Parquet, 1995, 7.
[112]Detailed in Dertouzos *et al*, 1989; and MIT Commission on Industrial Productivity, 1989.
[113]For example, see: "Utilities Rewrite the Rate Card."
[114]Navarro, 1995, 348. Also, for a study on the impact of electric power regulation on the competitiveness of American and Japanese manufacturing companies, see: Navarro, 1989.
[115]For example, see: Lester *et al*, 1995; and "What Do You Mean Taxachusetts?"
[116]Energy Information Administration, March 1993, viii.

sought approvals for mergers or petitions for market-based pricing of wholesale power sales. However, the FERC's "carrot and stick" efforts only impacted some utilities. By the early 1990s, competitive forces had continued to build and the limits of the FERC's carrot and stick policy were quickly reached.

B.6.4.2 PUHCA

At the turn of the decade, PUHCA was becoming increasingly burdensome to the growth of the NUG industry. In May 1991, there were only two operating "pure" IPP plants.[117] In testimony before Congress, P. Chrisman Iribe, Executive Vice President of PG&E/Bechtel Generating Company,[118] explained what his company faced. "We in the industry refer to these projects [pure IPPs] which have received approval from the SEC as PUHCA pretzels ... because of the tangled ownership and operating structure which is required to avoid becoming a holding company."[119] The consequence to companies such as PG&E/Bechtel was,

> Our projects take years and millions of dollars to reach the point of financing and being constructed (*sic*). They are carefully planned, financially sound, and environmentally sensitive. Yet, after the investment of our time, our capital, effort, and reputation in these projects, we would be forced to turn the operation of that project over to someone else, unless we are willing to live under the constraints of becoming a public utility holding company under the act.[120]

In short, because of the way that the industry was drastically changing from its 1930s-based structure, the law enacted to simplify ownership structures was now leading to ownership convolutions -- 1920s pyramids were causing 1990s pretzels.

B.7 TOWARD A COMPETITIVE INDUSTRY

B.7.1 The Energy Policy Act of 1992

The comprehensive Energy Policy Act of 1992 (EPAct) included several provisions that were of great significance to electric power industry deregulation. EPAct conferred to the FERC the authority to mandate wholesale wheeling, (although it explicitly withheld authority from the FERC to mandate retail wheeling).[121] EPAct also created a category of generating plants called "exempt wholesale generators" (EWGs), which allowed IPPs to circumvent PUHCA's restrictions. An EWG is defined as:

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[117]Iribe, 1991, 273. IPPs are NUG plants that do not meet the qualifications of QFs.
[118]Now U.S. Generating Company.
[119]Iribe, 1991, 274.
[120]Ibid., 273.
[121]PL102-486, 2915-2916.

> any person ... engaged directly, or indirectly through one or more affiliates ... exclusively in business of owning or operating, or both owning and operating, all or part of one or more eligible facilities and selling electric energy at wholesale.[122]

The law also liberalized rules on the investments of American utilities in foreign electric power projects.

In short, EPAct eliminated the most immediate impediments to continued NUG growth. It accomplished this through wholesale power sales mechanisms, which inherently meant a continued reliance on the old industry structure. To remove the next impediment to NUG growth, the exclusiveness of utility sales to retail customers, would require a fundamental restructuring of the industry.

B.7.2 Subsequent State and FERC Actions

Soon after the passage of EPAct, the FERC began its task of implementing the law's provisions, and while doing so, attempted to divine the future direction of the industry. The FERC was not the only regulatory body attempting to ascertain and direct the industry's future. As EPAct was being deliberated in Congress, the California Public Utilities Commission (CPUC) commissioned a study of the industry's past and future, which was completed in March 1993.[123] While this caused little more than a slight tremor at the time, it was the precursor to a much larger event. In April 1994 the electric power community was struck with an earthquake,[124] whose epicenter was located at the CPUC's headquarters, near the San Andreas Fault. By then another precursor had been felt -- the Michigan Public Service Commission proposed a limited experiment with retail wheeling a week earlier. But the one in California, with its call for retail wheeling by January 1996 for large customers, was the tremor that broke the dam restraining the competitive tides in the industry. Within months, public utility commissions and legislatures across the country were examining the issue of electric power industry restructuring.[125]

In the midst of this state-level debate, the FERC weighed in with a Notice of Proposed Rulemaking (known as the Mega-NOPR because of its length) on transmission access in a competitive environment. This proposal was intended to codify its case-by-case implementation of EPAct's transmission access provisions, to pre-empt the states and lay

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[122] PL102-486, 2905-2906.
[123] Dasovich *et al*, 1993.
[124] Source: "Michigan Tremor Precedes Cal. Regulatory Earthquake."
[125] See Chapter 5 for a much more complete discussion of this.

down a common framework for retail wheeling proposals, and to catalyze debate on important issues.

During the past two years, California has been the central battleground between interest groups vying to have their ideas for industry restructuring adopted.[126] In May 1995, the CPUC issued preferred and dissenting proposals, which touched off another round of controversy. It was not until late December 1995 -- less than two weeks before it had hoped to start implementation of its original proposal -- that the Commission made a final ruling on the issue, which still leaves some important issues unresolved.

Several important issues and trends have developed as utilities, independent power producers, regulators, and new entrants prepare for an industry whose only future certainty is that it will look drastically different than it does today. Let us briefly examine several of these issues and trends.

B.7.3 Reconsolidation of the Industry[127]

A plethora of mergers occurred in 1995 and early 1996,[128] which included:

- The combination of two Washington D.C. area utilities: Baltimore Gas and Electric and Potomac Electric;[129]
- The merger of two large Southwestern utilities: Public Service Company of Colorado and Southwestern Public Service;[130]
- The creation of Primenergy from two well-positioned Upper Midwest utilities: Northern States Power and Wisconsin Energy;[131]
- A triple merger of three other Upper Midwest utilities -- Wisconsin Power and Light, IES Industries, and Interstate Power -- into Mid America Energy;
- The failed hostile takeover of low-cost Pennsylvania Power and Light by high-cost PECO Energy;[132]
- The amalgamation of two Kansas City utilities: the entrepreneurial UtiliCorp United and the conservative Kansas City Power and Light;[133] and
- The merger of another Missouri utility, Union Electric, with one from across the Mississippi River, Central Illinois Public Service, to form Ameren.[134]

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[126]For more details, see: Holden, 28 November 1995.

[127]A compreshensive discussion of this topic is found in: Diamond and Edwards, 1996.

[128]For example, see: "Power Playtime;"

[129]Sources: "PEPCO to Merge With Baltimore Gas & Electric;" "Merger of Baltimore G&E, Potomac Electric Planned;" and "Baltimore Gas and Potomac Electric Agree to $2.9 Billion Merger."

[130]Source: "New Utility Merger to Form Regional Giant."

[131]Sources: "Two Big Midwestern Utilities Plan to Merge in a $3 Billion Deal;" "NSP Merger Plans Win Praise, Criticism from Market Analysts;" and "Northern States and Wisconsin Energy Reach Agreement for $3 Billion Merger."

[132]Sources: "A $3.8 Billion Takeover is Quite a Swan Song;" "Takeover Bids Made for Two Big Utilities;" and "PECO Unveils Hostile Offer for PP&L; Union Electric to Merge With CIPSCO."

[133]Sources: "UtiliCorp, KCPL Announce $3 Billion Merger;" "UtiliCorp in $3 Billion Deal With Kansas City Power;" and "UtiliCorp and Kansas City P&L Agree To Combine in a $1.35 Billion Merger."

[134]Sources: "Takeover Bids Made for Two Big Utilities;" and "Business Bulletin," November 1995.

There are two common threads in these mergers. The first is a desire on the part of utilities to capitalize on "synergies" by creating larger, regional electricity companies that are better positioned in a competitive market. Second, with the exception of the failed PECO merger, these have been "mergers of equals."

Underlying reasons for mergers include the opportunity to obtain: a more diversified fuel mix, undervalued assets, and/or larger transmission and distribution systems.[135] Recent surveys of regulators and industry executives conclude that this is only the beginning of the merger wave. For example, in a recent survey of utility executives, 48% of the respondents believe that their company "will eat or be eaten by another company" in the next decade; and 55% said that they are currently engaged in merger and acquisition discussions.[136]

B.7.4 Public Power: Expanding or Contracting?

Just as investor-owned utilities are experiencing a time of great upheaval, public power agencies are also at a crossroads.

B.7.4.1 Expanding?

Numerous cities are exploring the potential of creating municipal power agencies. At this point in time, municipalization is attractive because:[137]

- There are large disparities between the electric prices of different utilities; and[138]
- Municipal systems enjoy huge tax, regulatory, and financing advantages.[139]

The result is that some communities are attempting to create (or have created) a municipal utility. For example, the residents of Las Cruces, NM voted by a 2-1 margin to municipalize their city's distribution system.[140] The city has been served by the financially struggling El Paso Electric Co.,[141] whose rates are 94% higher than those of Southwestern Electric Power Company,[142] the city's desired wholesale supplier. In another case, power poles go down both sides of the street in Clyde, OH, where residents are served by the

[135]Source: "Inside Utility Mergers: Trends Within the Trend."
[136]Source: "Utilities Say Most Won't Be Here in Decade."
[137]Source: "The Muni Vote," 42.
[138]Under EPAct, municipal utilities have the ability to demand wholesale wheeling. Thus, a city served by a high-priced utility can gain access to less expensive power (and this option is not available to consumers on an individual basis.)
[139]Including freedom from state utility commission oversight, access to government bonding authority, and certain tax exemptions.
[140]Source: "Las Cruces Votes to Municipalize."
[141]Source: "El Paso Electric Co.: Proposal for Reorganization Clears Bankruptcy Court."
[142]Calculated from figures in: Energy Information Administration, November 1994.

incumbent utility, Toledo Edison, and the new municipal Clyde Light & Power.[143] This, like several other cases, occurred at the request of a large, local industrial firm (Whirlpool in this case) seeking to have its electricity rates cut. The largest municipalization effort, however, is occurring in New York state, where the Long Island Power Authority, a state agency, is empowered to purchase part or all of the assets of an IOU, Long Island Lighting Company (LILCO). If LILCO is purchased in whole, the move would create the largest non-federal public power agency in the United States.[144]

B.7.4.2 Contracting?

While municipal agencies may currently be on the upswing, this trend could soon reverse itself. It is quite possible that expanded competition will not be kind to public power -- municipal utilities, rural electric cooperatives (RECs), and the federal power agencies.

While the Energy Policy Act of 1992 gives municipal utilities unique advantages with respect to wholesale power purchases, these would be negligible in the event of retail wheeling. Entities sufficiently sophisticated to push for municipalization as a mechanism for lower rates (such as Whirlpool) would likely be able to find even lower individual rates in a retail wheeling environment. Hence, the same entities that have pushed for municipalization could turn cold on it once retail competition begins since the current interest in municipals is the result of regulatory distortions that could be eliminated in a restructured industry.

There were proposals in Congress during 1995 to privatize some of the Federal Power Marketing Agencies (PMAs). These proposals were supported by the Clinton Administration because the sale would bring in an estimated one-time, $3 billion windfall to the government treasury in an election year.[145] Eventually these proposals stalled in Congress.

Another potential cause for a future decline of public power is that some market participants and analysts believe that public power agencies would impede the efficient development of a competitive industry.[146] Because public agencies have lower tax burdens and cheaper access to capital, critics claim that an uneven playing field and efficiency distortions would

[143] Source: "The Rebellion in 'Pole City'."
[144] Source: "Lilco Not a Typical Case in Public Takeover Drives."
[145] Source: "Clinton May Revive Sale of PMAs in Budget Veto -- Ho Hum."
[146] Fyock, 1989; and Dahlberg, 1995.

be created in a competitive market. These analysts and industry players call for the privatization of all public power agencies.

If political pressures do not cause the decline of public power, economic pressures might -- especially for rural electric cooperatives (RECs). These agencies were established during the Great Depression to electrify rural areas. In most cases, RECs are distribution-only, TDUs. These entities face significant problems in a deregulated environment, many of which are the result of having a customer-base dominated by small, physically disperse electricity users,[147] which have relatively similar load profiles. Also, many RECs have a relatively small number of customers, which means that overhead expenses are divided among a relatively small group. To eliminate this problem, consolidation of RECs has begun and is expected to continue as they fight for survival in a competitive environment.[148]

B.7.5 Power Marketers and Brokers

There has been a significant increase in the number of electric power marketers and brokers in recent years. The first power marketer was certified in 1986[149] and their ranks have mushroomed since. In September 1995, one hundred sixteen companies had either received permission or applied to FERC to be certified as power markers.[150] By December 1995 that number had increased to nearly 150.[151] Despite these large numbers, only about ten had completed transactions as of December 1995.[152] This relative inactivity should change now that the New York Mercantile Exchange trades electricity futures contracts.[153] It is widely believed that power marketers and brokers, many of whom are armed with experience in the natural gas industry,[154] will play an important role in aggregating supply and demand in a restructured industry.

[147]This is a synthesis of a phone conversation with Steven Healy, General Manager of Pierce-Pepin Rural Electric Cooperative. Source: Healy, 1995.
[148]Sources: "Power in Alliances;" and "Municipals to Join Together."
[149]Stoddard, 8, 1995.
[150]Source: "A Powerful Future," 18.
[151]Marier, 1995.
[152]Ibid.
[153]Trading started 29 March 1996. Sources: "Exchange to Trade in Electricity Contracts;" and "Electricity Futures Have Crackling Debut."
[154]Enron is the quintessential example. For a good discussion of this company, see: Southerland, 1996. In addition to firms from outside the industry, a number of utilities have also created power marketing affiliates. Also see: "Chuck Watson's Power Play."

B.7.6 Stranded Investment

Probably the most hotly contested restructuring issue is stranded investments (SIs).[155] These "unused and useless"[156] assets are the casualties of a regulatory system that discouraged, if not prevented utilities from responding to price signals.[157] Stranded investments occur when facilities or contracts that were "economic" in the rate-of-return regulatory environment become uneconomic (unrecoverable) in a competitive market.[158] There are four broad types of stranded investments:[159]

- Stranded assets, primarily expensive power plants and excess capacity;
- Stranded liabilities, primarily power-purchase contracts (including those with qualifying facilities) and deferred income taxes;
- Regulatory assets (whose value is based on regulatory decisions rather than on market forces), including deferred expenses and costs for demand-side management programs that regulators allow utilities to place on their balance sheets; and
- Stranded public-policy programs, including tax collection, environmental compliance beyond that required by law, demand-side management programs paid for by all customers, special programs for low-income customers, and support for energy research and development.

Estimates of stranded investment run from $20 billion to $200 billion.[160]

There is significant disagreement about how to handle stranded investments. On one side of the issue are utilities, which generally assert[161] that they deserve full compensation for their stranded investments. This claim derives from a fundamental agreement between state commissions and utilities, commonly termed the "regulatory compact." By this tacit, if not explicit agreement, utilities were given a monopoly service franchise; in return, utilities were obligated to serve all customers within their franchise area, had their earnings capped, and were required to plan and provide for all of the demand of their customers in a reliable manner. Arguing on the basis of this regulatory compact, those in favor of stranded investment recovery claim that the government is morally obligated to ensure the opportunity for fair compensation for stranded investments.[162] They state five reasons for this. The first is that in the absence of stranded investment recovery, utilities would face asymmetric risks -- they would subject to unlimited losses now, while their ability to earn a

[155]Tabors Caramanis & Associates, 1995, 39.
[156]Michaels, 1994.
[157]These distortions were exacerbated, at least in some cases, by bad luck and/or gross utility mismanagement.
[158]In the case of generation facilities, the power produced by these assets would not be able to be sold at a price high enough for utilities to recover their full costs.
[159]Baxter and Hirst, 1995, 1-2.
[160]Baxter and Hirst, 1995.
[161]Some of the well-positioned utilities are opposed to stranded investment recovery, however.
[162]This view is backed by some observers. For example, see: Kahn, 25 July 1994.

return on them (when they were economic) was capped by the rules of the regulatory structure that existed. Second, utilities had been serving the public under the expectation that the state would allow them to earn a fair rate of return; and based upon that expectation, the utilities invested in expensive, long-lived assets. Trust in the government would be undermined if, as the state changes the rules of the industry, utility investors lose some of their investments. Third, some of the stranded investments -- especially power purchase contracts, regulatory assets, and public policy programs -- were forced upon the utilities. It would not be fair to make the utilities liable for costs they did not want to incur, and often vigorously fought. Fourth, most of the "uneconomic" investments were deemed by past public utility commissions to be in the public interest when they were built. And finally, these utilities believe that in order to be effective competitors in a deregulated industry, they must be "made whole." If they are forced to bear losses from the "old era," an unlevel playing-field would be created.

Large industrial users and those who wish to enter the generation market counter that these assets should be considered economic "sunk costs." They argue that the investments have been made, conditions have changed, and as in any other business, the utilities should be responsible for their losses.[163] They further assert that any attempt to ameliorate these losses would produce pricing inefficiencies and market distortions.[164] Robert Michaels captures the arguments of this camp when he states, "SIC [stranded investment compensation] is the last gasp of cost-of-service rate-making in the face of competition."[165]

Aggravating this conflict is the widespread expectation that electricity demand will remain relatively flat (annual growth is predicted to be between 0.8% and 1.7% over the next two decades).[166] This makes the stranded investment debate a zero-sum game. Other industries that have been deregulated have also faced transition issues, but in most cases, their demand increased with time.[167] For example, the telephone industry is facing large transition costs caused by the advent of competition in local service and the obsolescence of

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[163]For a good description of this point of view, see: Michaels, 1994.
[164]In a recent article, Paul Joskow disputes this argument. Source: Joskow, April 1996.
[165] Michaels, 1994, 20.
[166]Energy Information Administration, January 1995; and Energy Information Administration, January 1996.
[167]A notable exception is the natural gas industry. For example, see: Strand, 1994, 35.

some equipment that will result.[168] However, these costs are being absorbed without too much difficulty due to the expected continuing boom in telecommunications.[169]

But is the assumption of relatively flat electricity demand correct? If, as expected, prices decline in a deregulated market, will not load grow in response? The long-run price elasticity of demand for electricity is relatively high. (See Table B.2) However, there is an important caveat: load will probably shift away from the most expensive (and stranded) generating assets as customers take advantage of lower, off-peak rates. In short, lower-cost facilities that sit idle during parts of a typical day will see their capacity factors rise. This would not help some of the more expensive stranded plants. Therefore, demand could rise precipitously without contribution to the resolution of the stranded investment problem.

Table B.2: Long-Run Price Elasticity of Demand for Electricity

Customer Class	Number of Studies	Range of Price Elasticities	Average Price Elasticity	Conclusion
Residential	31	-.44 to -1.89	-1.01	slightly elastic
Commercial	8	-.56 to -1.60	-1.23	elastic
Industrial	9	-.51 to -1.82	-1.21	elastic

Source: Wisconsin Public Service Commission, July 1995, 128.

The stranded investment issue is of particular importance to the nuclear power sector. While not the only source of stranded investment, uneconomic nuclear power plants are the largest contributors to it.

Recently, the Massachusetts Institute of Technology (MIT) received the dubious distinction of being the first entity to be charged a stranded investment fee, when it left the service of Cambridge Electric Light Company by bringing its own cogeneration unit on-line.[170] The Massachusetts Department of Public Utilities assessed the fee, which is intended to cover 75% of the stranded investment costs that Cambridge Electric will incur over the first five

[168]Six of the seven "Baby Bells" have taken major depreciation write-downs. See: "Pacific Telesis Plans a Charge of $3.3 Billion."

[169]For example, see: "The Coming Telescramble." Similar costs were incurred for the AT&T break-up, but they were recovered as a result of the significant increase in long distance calling volume that followed divestiture.

[170]Sources: "Massachusetts Orders Payment to Utility By User That is Switching Power Source;" and "MIT Criticizes DPU Decision Charging $100,000 per Month."

years that MIT is off Cambridge Electric's system.[171] While the $6.5 million involved in the MIT case is relatively minor compared to the hundreds of billions of dollars of stranded investment, the case has attracted much attention as it sets a precedent. The FERC denied MIT's appeal of the ruling in Febraury 1996,[172] and now MIT has requested that the DPU reconsider its decision.[173]

With so much money at stake, in all likelihood: the debate will continue to be intense, compromise will not be easily reached, and retail wheeling will not occur until a "satisfactory" resolution is reached.

B.7.7 Overseas Expansion

Just as PURPA spawned unexpected changes in the industry, so too has the Energy Policy Act. While it was expected that the two most significant provisions of the Act with respect to electric power industry structure would be the creation of the EWG (Exempt Wholesale Generator) category of plants and the open access transmission provisions, it could be argued that the most important effect of the Act to date has been the provisions allowing American utilities to invest in foreign operations. While demand in the United States is stagnant and the country is faced with significant overcapacity, much of the rest of the world is clamoring for electricity.[174] American firms with extensive operating experience -- both IPPs and utility IPP affiliates -- are circling the globe. For example, the trade publication *Independent Energy* has systematically tracked IPP investments since 1989. During that year, foreign IPP activity was negligible.[175] In the first half of 1993, seventeen percent of all American IPP deals occurred outside the United States;[176] by the second half of 1995, it had risen to 71%.[177]

Not only are American companies building plants in the growing Third World,[178] they are also acquiring assets in relatively mature markets, such as the United Kingdom, Australia,

171 The five year increment was chosen because at current Cambridge load growth rates, the 20 MW used by MIT would be replaced through new demand in about 5 years.
172 Source: "FERC Upholds Stranded Cost Charge in MIT Cogen Case."
173 Source: "MIT Stranded Cost Flap Ain't Over 'til It's Over."
174 See, for instance: Javetski, 1996; Churchill, 1996; Rainbow, 1996; and Roseman and Malhotra, 1996.
175 Marier, 1995, 2.
176 Ibid.
177 Anderson, 1996, 16.
178 For a discussion of the booming, yet dangerous Asian market, see: "Asia Delivers an Electric Shock;" and Burr, 1996.

and Chile (all of which have undergone deregulation).[179] One of the benefits of buying into these markets is that organizational competencies can be gained from operating in a competitive market that should be helpful when the American generation market is deregulated.[180]

Having explored some of the major trends in the industry, let us grapple with an examination of the inefficiencies in the current system which provide the largest impetus for industry restructuring.

B.8 SOURCES OF INEFFICIENCY IN THE CURRENT SYSTEM

B.8.1 Excess Capacity in the New Industry Paradigm

The generation overcapacity situation created by poor utility planning in the 1970s has been reduced through a combination of load growth and substantial reductions in capacity expansion, but it still remains an issue. In recent years, the capacity margin (calculated using *peak* demand) has fallen back to 1973 levels,[181] but the annual load factor (a proxy for capacity relative to average demand) has remained relatively low, at approximately 61%.[182] While the absolute reserve margins and load factors were equivalent in 1973 and 1993, the context of the industry changed dramatically during the intervening two decades. In 1973, capacity margins, and their costs, were viewed as being part of the price of high reliability. While reliability concerns are important yet today, the existence of these large capacity margins serves as an incentive to consummate wholesale power trades, as utilities seek to minimize their expenses and efficiently utilize their assets. As a result, "excess" capacity, even though it might be needed for reliability purposes, serves as a driver for increased competition.

The FERC's Mega-NOPR is an attempt to remove the barriers that are now restraining the industry's evolution into an active wholesale market. Furthermore, because of the industry's changed mind-set, the downward price pressures caused by excess capacity are one of the forces that could facilitate the creation of retail competition.

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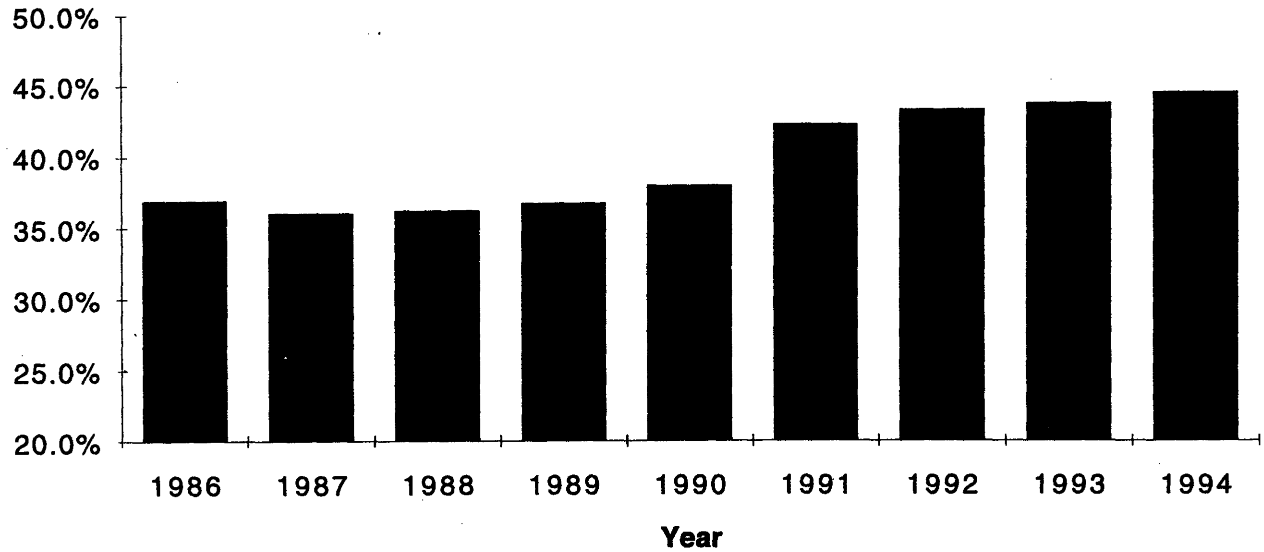
[179] See, for example: "Pacificorp Joins Global Treasure Hunt;" and "In U.K. Electricity-Concern Takeover, Up to $31.72 Billion May Change Hands."

[180] "Source: U.S. Utilities Buy in Britain to Learn Deregulation for Home Use."

[181] Energy Information Administration, January 1995, 31.

[182] Sources: "Gale: Beware the Permanent MW Surplus;" and Edison Electric Institute, *Statistical Yearbook of the Electric Utility Industry 1994*, 85.

Figure B.3 (Utility Sales for Resale and Non-Utility Power Sales) as a Percentage of (Net Utility Generation and Non-Utility Power Sales)



Sources: Energy Information Administration, 1990, 2.
Energy Information Administration, February 1993, 79.
Energy Information Administration, February 1994.
Energy Information Administration, November 1995a, 59.

B.8.2 Expensive Plants

The legacy of the expensive plants which initially caused the capacity surplus lives on in the rate-base, since generating plants are depreciated over multiple decades. Even though the incremental cost of power from these plants, especially the nuclear ones, is low, the cost of capital recovery makes power from these plants uncompetitive in many cases.

B.8.3 Utilities as Vehicles of Social Programs

In recent decades, utilities became important vehicles for social programs, both in terms of provision and funding. These programs have included electric vehicle R&D, demand-side management (DSM) programs, renewable energy R&D, non-interruptable service for poor people, and procurement practices that assist women- and minority-owned businesses. Advocates have viewed electric utility rates as an efficient funding source for their pet programs. From their perspective, the use of utilities as vehicles for these programs is highly effective, "Happily, these costs could easily be absorbed by that inexhaustible source of revenues, the rate base -- an invention more ruthlessly efficient in collecting taxes than even the IRS,"[183] Vinod Dar observes. However, collecting what are essentially tax revenues through electric rates produces economic distortions since the price that customers pay for electricity can be substantially higher than the cost of its production. As Alfred Kahn comments, "Economic welfare is a not a goal to be lightly dismissed, as it is all too often by well-educated, well-to-do intervenors in regulatory proceedings."[184] These distortions have lead some industry stakeholders, most notably large electricity users, to suggest that other mechanisms for achieving these social goals should be developed in a restructured industry.[185]

Because utilities have served as vehicles for a variety of social policies, resistance to deregulation has produced some strange bedfellows. For example, the same environmentalists who have consistently rebuked utilities on issues ranging from nuclear power to acid rain, have marched in step with the utilities that are resisting the move to a competitive industry.

B.8.4 <u>New Technologies</u>

A major impetus for competition has been the development of new technologies. In particular, the technological development trajectory started in the 1980s has become increasingly important in the 1990s. In the past 6 years alone, the heat rates of combined-cycle gas turbines have improved by 20%.[186] With thermal efficiencies now approaching 60%,[187] these new technologies enable generators to obtain almost twice as much electrical output from the same amount of energy input in more traditional plants (such as large coal and nuclear plants). As a result, the gas turbines are more economically efficient and environmentally responsible. These technologies also offer significant reductions in emissions (compared with traditional coal plants).

In addition to their purely technical efficiencies, gas turbines are well suited to the current power generation market conditions. One major benefit is that they come in relatively small sizes, yet have per unit capital costs that are one-fourth those of large coal plants.[188]

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[183] Dar, 1994, 59.
[184] Kahn, October 1994, 25.
[185] Knight, 1995, 91.
[186] Levy, 1996, 89.
[187] Source: "GE Develops Generator with 60% Efficiency."
[188] Bayless, 1994, 21.

Another benefit is that in an industry with relatively slow growth, gas turbines allow for incremental capacity enlargements that are more appropriate for demand conditions than larger plants. In other words, gas turbine plants have changed the economies of scale of generation. In the 1980s it was presumed that 1000 MW coal plants would be the most economically efficient,[189] but today it is 100 MW gas turbines that set the standard.[190] For all of these reasons, the new technologies have led to a large gap between the cost of electricity that they produce and the cost of electricity generated using older technologies.

Furthermore, the low capital costs of the new generation technologies (on the order of $100 million) make it possible for many firms and investors to contemplate entry into the business. These same firms could not enter the industry in the past because scale economies dictated that plants cost an order of magnitude more. This is significant because competitive markets can develop more easily in an industry with many small competitors than in one with a handful of large plants.

All of these reasons, combined with low natural gas prices,[191] have made gas turbines the generation technology of choice in the 1990s and beyond. In the next decade, the amount of new natural gas-fueled capacity is expected to be an order of magnitude higher than the amount of new coal capacity.[192]

B.8.5 Expensive Wholesale Power Contracts

Another cause of current inefficiencies, quite ironically, is PURPA itself. If it were not for its unanticipated consequence of catalyzing deregulation, PURPA could be viewed even more unfavorably than the Energy Security Act of 1980 (probably the most expensive

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189For example, see: "Coal-Fired Power Plants: Efficient *and* Reliable."
190For example, see: "Combined Cycle Lead Efficiency Race;" and Bayless, 1994.
191However, there is one caveat that is rarely mentioned or evaluated -- the technologies that are undermining the natural monopoly in generation are based upon natural gas fuel. Currently, natural gas is relatively cheap and bountiful, but what would happen if sharp increases in demand or external events lead to significantly higher prices? This is a question that few are asking and fewer are answering, Peter Navarro, a strong advocate of deregulation (see: Navarro, 1996), believes that it deserves further examination. He notes that current conventional wisdom asserts that these plants "truly spell the death of natural monopoly in the generation market... This claim is a primary basis for the overall restructuring efforts." Source: Navarro, 1995, 353. He goes on to say, "It is an open question, however -- and one that should be put on the research agenda -- what the impact of a severe petroleum price shock might be on the relative economics of these different power plant options. It may be that in a world of high gas prices, the relative competitiveness of gas-fired plants may turn out to be an illusion." Source: Ibid., 357.
192For aggregate statistics, see: Energy Information Administration, July 1995b, 11; and Energy Information Administration, October 1995, 242. For detailed statistics, see: Energy Information Administration, October 1995, 232-241.

failure of President Carter's various energy policies).[193] PURPA's implementation by the FERC and state commissions created a huge subsidy for non-utility generators. While this subsidy helped create the NUG industry, it still continues, despite the growth and financial health of NUGs. After uneconomic utility generation investments, PURPA-related uneconomic power purchase contracts are the most significant component of the stranded investments problem,[194] costing as much as $38 billion in above-market power purchases.[195] As a result, there is significant pressure to repeal PURPA.[196] In addition to the QFs that are receiving subsidies, there are many analysts who oppose PURPA repeal since the Act was an effort to promote environmentally beneficial technologies and energy security, not a law to promote deregulation.[197]

B.8.6 Gap Between Embedded and Marginal Cost

These factors combine to create a situation where the embedded cost price of power (which is currently the nearly-universal pricing method in the United States) is much higher than the marginal cost of electricity. As Alfred Kahn notes, "If there is one principle in economics that corresponds to the physical law that nature abhors a vacuum, it is that society abhors a great gap between marginal cost and price."[198] Therefore, these factors, along with political ones that are discussed elsewhere in this appendix, are driving today's debate.

Having now explored the industry's past and present, let us briefly examine where the industry restructuring appears to be heading.

B.9 THE FUTURE

While the precise path and pace of electric power industry restructuring cannot be predicted,[199] it would appear that the continuing move to a less regulated industry is inevitable. The industry's specific technological and economic characteristics will play a role in shaping the future direction of the industry. However, an equal or greater contribution to the industry's future direction and structure will result from the political processes that determine the rules for the new competitive era.[200]

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[193]See, for instance: Salpukas, October 1994; Salpukas, April 1995; and "Engineer's Ice Plant Helps Power County."

[194]Navarro, 1995, 371.

[195]Burkhart, 1996, 38.

[196]For an early 1996 update on these efforts, see: Schuler, 1996, 40.

[197]For a thorough discussion of this viewpoint see: Cudhay, 1995.

[198] Kahn, October 1994, 26.

[199]Pierce, 1994, 349.

[200]Dar, 1994. See also: "Showtime for the Watchdog;" and Holden, November 1995.

The challenge in creating an efficient industry structure is to make appropriate connections between two "parallel universes": the technical operation of electric power systems and the industry's financial workings. While the technical and financial "universes" function separately, they cannot function independently. Decisions in one have implications for the other. In a deregulated industry, the physical flows of electricity and the financial flows of money could be very different,[201] but they should be reconciled in a manner that signals the efficient use of physical and financial resources in the short- and long-run. A further complication is that the physical universe is constrained by existing massive infrastructures which must obey the laws of physics and have generally been technically operated in a laudable manner. Consequently, a restructuring objective should be to reconstitute the industry's financial structures while maintaining (or making few changes to) its enviable physical operation.

[201]For illustrative figures of the differences in path flows under different scenarios, see: Thesis Figure 3.4; Hirst and Kirby, 1995, 13; Tabors et al, 1995, iii; and Massachusetts Senate Committee on Post Audit and Oversight, 1995, A2-A7.

Appendix C
Utility Response to Competition Data

An electric power system is the largest physically interconnected system that man has invented.[1] -- *Fred Schweppe (1978)*

C.1 EXPLANATION OF DATA

The appendix contains two series of data. The first 17 pages (one page per utility) consists primarily of qualitative data, although the main quantitative findings are also in this series. The second series of data, also one page per utility, is the "raw" quantitative data.

C.1.1 Series 1

- For the categories: **Recognition of Competition, Downsizing, Reengineering,** and **TQM** a **YES** indicates that the utility shows evidence of this behavior and a **no** indicated that it does not.
- For the 6 "Best Practice" qualities, a "**0**" means that there is no evidence of best practice, a "**1**" indicates that there is evidence in at least some parts of the company, and a "**2**" indicates the best practice characteristic appears to be widespread in the utility.
- The **Rating on the Stage of Development** is the Gardner-Gilson rating for the utility.
- The **# of employees, mWh sold**, and **mWh sold/employee** categories should be self-evident, although there are few entries in them and they are ignored in the analysis of the data.
- The **Price** is the average price for all of the utility's customers.
- The **Price/Region** is the regional competitiveness ratio.
- The **Dominant Theme** is the dominant theme of the annual report.

C.1.2 Series 2

- In the **Operating Company** column are the operating companies of the given utility. The sales of the operating company are broken down by state in the event that the operating company serves multiple states. In some cases, there is just one entry (when the utility consists of one operating company operating in only one state); however, where there are holding companies, there are multiple entries.
- The **State/%** column indicates the state that the operating company serves, as well as the percentage of 1994 sales that occurred in the state.
- The **Revenue** columns (for **1989** and **1994**) indicate the revenue of each operating company in each state. A "1" in the 1994 column indicates that all of the utility's revenues were generated by one operating company in one state.
- The **Price** columns (**1989** and **1994**) indicates the price charged by the operating company in the states in which it operates.
- The **State Price** columns (**1989** and **1994**) list the average price for the entire state.
- The **Totals** row indicates the total revenue for the utility for the year.
- The **Average Rate** (**89** and **94**) indicates the average rate of the utility for all of its operations.
- The **Ave local rate** (**89** and **94**) is the weighted average rate of all of the states in which the utility operates.

NOTE: Quantitative data came from: EIA, 1989 and 1994.

C.2 PRESENTATION OF DATA

[1] Schweppe, 1978, 42.

UTILITY:	SOUTHERN CALIFORNIA EDISON						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	no	YES	YES	YES	YES	YES	
Downsizing	no	no	no	YES	YES	no	YES
Reengineering	no	no	no	no	no	no	
TQM	no	no	no	no	no	no	
Simultaneous Improvement in cost/quality/ service	0	0	0	2	2	0	
Close to Customer	2	2	2	2	2	2	
Closer to Suppliers	0	0	0	0	0	0	
Technology for Strategic Advantage	0	2	2	2	2	0	
Flatter/less compartment. organizations	0	0	1	2	0	0	
Innovative Human Resource Pol.	0	0	0	0	0	0	
Rating on stage of development	1.1	1.6	1.9	2.7	2.8	2.9	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	10.0379		Price Change (1989-1994)			10.38	
Price/Region	118.1%		$\boxed{3.4\%}$			106.1%	
Dominant Theme	None	Electric Vehicles	Conservation		Competition	Competition	

UTILITY:	AMERICAN ELECTRIC POWER						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	no	no	YES	YES	YES	YES	YES
Downsizing	no	no	no	no	no	no	
Reengineering	no	no	no	no	no	no	
TQM	no	no	no	no	no	no	
Simultaneous Improvement in cost/quality/ service	0	0	0	0	0	0	
Close to Customer	0	1	1	1	1	2	
Closer to Suppliers	1	0	1	1	0	0	
Technology for Strategic Advantage	2	2	2	2	2	1	
Flatter/less compartment. organizations	0	0	0	1	0	0	
Innovative Human Resource Pol.	0	0	2	0	0	2	
Rating on stage of development	1.1	1.5	1.7	2.3	2.6	3.1	
# of Employees			22100	20800	20007	19660	
mWh sold							
mWh sold/ Employee							
Price	4.82356		Price Change (1989-1994)			5.10755	
Price/Region	88.0%		5.9%			87.7%	
Dominant Theme	Glowing Promise of Clean Coal	Energy Wise	Transmis-sion reliab-ility	Money and Resources Together	Conservin g Our Future	New Directions	
	In 1991, for the 1st time since WWII, AEP was not building a plant						
	Zinner - nuclear turned coal plant that was not fully paid for						
	89-1174	90-1436	a0404	A0600	841	1071	

UTILITY:	TEXAS UTILITIES						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	no	no	YES	YES	YES	YES	
Downsizing	YES	YES	YES	YES	YES	YES	no
Reengineering	no	no	no	YES	YES	no	
TQM	no	no	YES	no	no	no	
Simultaneous Improvement in cost/quality/ service	0	0	2	0	2	2	
Close to Customer	2	0	2	0	2	2	
Closer to Suppliers	1	1	2	2	2	2	
Technology for Strategic Advantage	0	0	2	0	1	2	
Flatter/less compartment. organizations	1	1	2	2	2	2	
Innovative Human Resource Pol.	0	0	1	0	0	1	
Rating on stage of development	1.3	1.3	2.8	3	3	3.2	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	5.33778		Price Change (1989-1994)			6.67	
Price/Region	93.6%		25.0%			103.9%	
Dominant Theme	Customer Needs in the New Decade	The Commitm ent Continues	Commitm ent to Service	Stay Competiti ve Tomorrow	Serving a Dynamic Energy Future	Golden Anniversa ry	
					93-1085	94-1225	
	89-1067	90-1307	434	605	874	1105	

UTILITY:	UNICOM (COMMONWEALTH EDISON)					
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	no	no	no	YES	YES	YES	
Downsizing	no	no	no	YES	no	no	YES
Reengineering	no	no	no	no	no	no	
TQM	YES	YES	YES	YES	YES	no	
Simultaneous Improvement in cost/quality/ service	2	1	1	0	0	0	
Close to Customer	2	2	2	0	0	2	
Closer to Suppliers	2	0	0	0	0	0	
Technology for Strategic Advantage	0	0	0	0	0	0	
Flatter/less compartment. organizations	0	0	0	2	0	0	
Innovative Human Resource Pol.	0	0	1	0	0	0	
Rating on stage of development	1	1	1	1.3	1.8	2	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	8.17647		Price Change (1989-1994)			7.92	
Price/Region	109.0%		-3.1%			106.9%	
Dominant Theme	Vision	Committed to Customers	Responsibility and Rewards	Trying Year	Emerging Stronger for Competition	A Better Idea for the Future	
	89-1200	90-1284	394	605	804	1046	

UTILITY:	PACIFIC GAS AND ELECTRIC						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	YES	no	YES	YES	YES	YES	
Downsizing	no	no	no	no	YES	YES	
Reengineering	no	no	no	no	no	no	
TQM	no	no	no	no	no	no	
Simultaneous Improvement in cost/quality/ service	1	0	2	0	2	2	
Close to Customer	2	0	2	1	2	2	
Closer to Suppliers	0	0	0	0	0	0	
Technology for Strategic Advantage	0	0	2	1	0	0	
Flatter/less compartment. organizations	0	0	0	2	2	2	
Innovative Human Resource Pol.	learning center 2	0	2	2	0	0	
Rating on stage of development	1.3	1	1.4	1.6	1.8	2.2	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	8.70884		Price Change (1989-1994)			10.55	
Price/Region	102.5%		21.1%			107.9%	
Dominant Theme	Employees	Environment	Successful Year	Energy Efficiency	On Course in Changing Times	Blueprint for Success	
			develop plans in teams	$125M in training			
	89-1377	90-1181	410	583	810	1134	

UTILITY:	THE SOUTHERN COMPANY						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	YES	YES	YES	YES	YES	YES	
Downsizing	no	no	YES	YES	no	no	no
Reengineering	no	no	no	no	no	no	
TQM	no	no	no	no	no	no	
Simultaneous Improvement in cost/quality/ service	2	2	1	2	2	2	
Close to Customer	2	2	2	2	2	2	
Closer to Suppliers	0	2	0	0	0	0	
Technology for Strategic Advantage	0	0	0	2	1	1	
Flatter/less compartment. organizations	0	1	0	0	2	1	
Innovative Human Resource Pol.	2	2	0	2	2	2	
Rating on stage of development	1.9	2	2.2	2.6	2.8	2.9	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	5.90197		Price Change (1989-1994)			7.16682	
Price/Region	95.8%		21.4%			97.8%	
Dominant Theme	Industry - Our plan to succeed in the 1990s	Problems and shaping our opportunities	Mixed	Selling Efficiency	New Challenges, Continued Strength	Today's Success: A Powerful Future	
In 1994, 18 states REQUIRE bidding for new power plants (p. 13).							
				So.Co. College	Real Time Pricing		
		Since 1973, large customers in GA have had the opportunity					
		to "shop" for power when they build a plant					

UTILITY:	DUKE POWER					
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	YES	YES	YES	YES	YES	YES	
Downsizing	no	YES	YES	no	no	YES	YES
Reengineering	no	no	no	no	no	YES	
TQM	no	no	YES	YES	YES	YES	
Simultaneous Improvement in cost/quality/ service	2	2	0	1	0	2	
Close to Customer	2	2	2	2	2	2	
Closer to Suppliers	0	0	0	0	2	0	
Technology for Strategic Advantage	1	0	0	0	0	1	
Flatter/less compartment. organizations	0	0	2	2	2	2	
Innovative Human Resource Pol.	2	2	2	2	2	0	
Rating on stage of development	1.8	2	2.6	2.6	3	3.2	
# of Employees		19449	18187		18274	17052	
mWh sold							
mWh sold/ Employee							
Price	5.62593		Price Change (1989-1994)			5.60932	
Price/Region	93.4%		-0.3%			88.3%	
Dominant Theme	Hurricane Hugo	The Company of Choice	Strategy for the Future	Company of Choice	Quality Improvem ent	Making the Pieces Fit	
				Teams	Was going to start a TQM		
					for suppliers		
	89-1354	90-1157	406	592	820	1061	

UTILITY:	FPL GROUP						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	YES	YES	YES	YES	YES	YES	
Downsizing	no	no	YES	no	YES	no	no
Reengineering	no	no	no	no	no	YES	
TQM	YES	no	YES	YES	no	no	
Simultaneous Improvement in cost/quality/ service	2	0	1	1	1	1	
Close to Customer	2	0	2	2	2	2	
Closer to Suppliers	0	0	0	0	0	0	
Technology for Strategic Advantage	0	0	0	0	1	remote meters/ billing 2	
Flatter/less compartment. organizations	0	0	2	2	2	2	
Innovative Human Resource Pol.	0	0	0	0	0	0	
Rating on stage of development	2	2	2.5	2.7	3	3.1	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	7.39069		Price Change (1989-1994)			6.85	
Price/Region	105.6%		$\boxed{-7.3\%}$			98.4%	
Dominant Theme	Competiti on	Innovation s in a Changing Industry	Closer to Our Customer s	Team Work	An Excellent Year for FPL	The Changing Landscap e	
						95-1139	
	89-1376c	90-1199	406	593	825	1067	

UTILITY:	ALLEGHENY POWER SYSTEM						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	no	no	YES	YES	YES	YES	
Downsizing	no	no	no	no	no	no	no
Reengineering	no	no	no	no	no	no	
TQM	no	no	no	no	no	no	
Simultaneous Improvement in cost/quality/ service	0	0	0	0	1	1	
Close to Customer	0	0	1	1	1	1	
Closer to Suppliers	0	0	0	0	0	0	
Technology for Strategic Advantage	0	0	1	1	1	IT: 1	
Flatter/less compartment. organizations	0	0	0	0		0	
Innovative Human Resource Pol.	0	0	0	0	0	0	
Rating on stage of development	1	1	2	2	2.1	2.5	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	4.52034		Price Change (1989-1994)			5.46467	
Price/Region	72.4%		$\boxed{20.9\%}$			80.1%	
Dominant Theme	Relatively Good Year	Rate Relief	Eventful Year	Eventful and Good Year	Eventful and Good Year	Eventful and Productiv e	
			Perceived and Denied the value of competition				
				Most BORING REPORTS!!!			
	89-1164a	90-1352	414	582	814	1055	

UTILITY:	ENTERGY						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	YES	YES	YES	YES	YES	YES	
Downsizing	no	no	YES	YES	no	YES	no
Reengineering	no	no	no	no	no	no	
TQM	YES	YES	YES	no	no	no	
Simultaneous Improvement in cost/quality/ service	2	2	1	0	2	1	
Close to Customer	2	2	0	0	large ones 1	1	
Close to Suppliers	0	0	0	0	0	0	
Technology for Strategic Advantage	1	help customers use 2	IT 2	IT 2	IT 2	0	
Flatter/less compartment. organizations	merge nuke plants 1	2	2	2	2	2	
Innovative Human Resource Pol.	Incentive pay 2	Incentive pay 2	0	0	Incentive pay 2	0	
Rating on stage of development	2	2.1	2.8	3.2	3.4	3.4	
# of Employees	13190					15543	
mWh sold						89544	
mWh sold/ Employee							
Price	6.45332		Price Change (1989-1994)			6.40227	
Price/Region	104.9%		-0.8%			101.4%	
Dominant Theme	Salute to Innovation	Creation: Bringing Ideas to Reality	Are you Ready for the Year 2000?	The new Way to Look at Electric.	Winning The Energy Game	Why Entergy?	
			Functional lines reorgan.				
	89-1293b	90-1302	A0424	93-1077	94-1138	A1132	

UTILITY:	DOMINION RESOURCES						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	YES	YES	no	YES	YES	YES	
Downsizing	YES	YES	no	YES	no	YES	YES
Reengineering	no	no	no	no	no	YES	
TQM	no	no	no	no	no	no	
Simultaneous Improvement in cost/quality/ service	0	0	0	0	0	2	
Close to Customer	0	0	1	1	0	2	
Closer to Suppliers	0	0	0	0	0	0	
Technology for Strategic Advantage	0	0	0	1	2	1	
Flatter/less compartment. organizations	0	0	0	0	0	0	
Innovative Human Resource Pol.	0	0	0	0	0	0	
Rating on stage of development	2.3	1.6	1.2	2	2.9	3.2	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	6.14355		Price Change (1989-1994)			6.51	
Price/Region	103.9%		$\boxed{6.0\%}$			101.2%	
Dominant Theme	Strength Flexibility & Evolving Strategy	We Care	Now, and for the Future	Our Business is Electric.	Prepared for a Changing Industry	Creative Energy	
				Low cost strategy			
				Pacificcorp and Union Electric			
	89-1202	90-1157	A0424	A0606	A0865	A1081	

UTILITY:	PACIFICORP						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	no	no	YES	YES	YES	YES	
Downsizing	YES	no	no	no	no	no	YES
Reengineering	no	no	no	no	no	no	
TQM	no	no	no	no	no	no	
Simultaneous Improvement in cost/quality/ service	0	0	0	1	1	2	
Close to Customer	0	1	0	1	0	0	
Closer to Suppliers	**********	**	Through Ownership		******	******	
Technology for Strategic Advantage	0	0	0	0	0	1	
Flatter/less compartment. organizations	0	0	1	1	0	0	
Innovative Human Resource Pol.	0	0	0	0	0	0	
Rating on stage of development	1	1	1.1	1.4	2	3	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	4.93042	.	Price Change (1989-1994)			4.69941	
Price/Region	101.0%		-4.7%			98.0%	
Dominant Theme	Achievement	Energy Utility	none	Difficult Year	Changing Industry	Competition	
						restructuring	
	89-1290	90-1287	A0434	A0616	A0853	95-1192	

UTILITY:	CONSOLIDATED EDISON						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	no	no	no	YES	YES	YES	
Downsizing	no	no	no	no	no	no	no
Reengineering	no	no	no	no	no	no	
TQM	no	no	no	no	no	no	
Simultaneous Improvement in cost/quality/ service	0	0	0	0	0	0	
Close to Customer	DSM prog. 1	1	1	Reorganiz service 1	1	1	incentive rates
Closer to Suppliers	0	0	0	0	0	0	for business
Technology for Strategic Advantage	2	1	2	2	2	IT 2	
Flatter/less compartment. organizations	0	0	0	0	0	0	
Innovative Human Resource Pol.	0	0	0	learning center/ women & minor. 2	learning center/ women & minor. 2	learning center/ women & minor. 2	
Rating on stage of development	1	1	1	1.2	1.6	2.1	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	11.8459		Price Change (1989-1994)			13.2	
Price/Region	133.1%		$\boxed{11.4\%}$			120.9%	
Dominant Theme	Energy Efficiency and Record Year	Energy Efficiency	Good year	Challenges and Changes	People working with people	The World's Greatest Market place	
The company managed 20% reduction in workforce between 1980 and 1994 through attrition							

UTILITY:	NIAGARA MOHAWK						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	no	YES	no	YES	YES	YES	
Downsizing	no	YES	YES	YES	YES	YES	no
Reengineering	no	no	no	no	YES	YES	
TQM	no	no	no	no	no	no	
Simultaneous Improvement in cost/quality/ service	0	1	2	1	2	1	
Close to Customer	1	1	2	0	1	2	
Closer to Suppliers	0	0	0	0	1	0	
Technology for Strategic Advantage	0	0	0	0	1	0	
Flatter/less compartment. organizations	0	2	2	2	2	1	
Innovative Human Resource Pol.	0	incentive pay 1	1	1	gains bargaining 1	0	
Rating on stage of development	1	1.5	1.6	1.8	2.1	2.8	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	6.69		Price Change (1989-1994)			9.38	
Price/Region	75.2%		$\boxed{40.2\%}$			85.9%	
Dominant Theme	7 Point Plan for Prosperity	Become the Most Responsive & Efficient Energy Serv. Co.	The Right People and The Right Org.	Building on a Tradition of Quality and Service	Strengths on Which to Build	Challenge and Opportunity	
		Business Units					
	89-1196	90-1249	A0413	A0594	A0827	A1110	

UTILITY:	NORTHERN STATES POWER						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	YES	YES	YES	YES	YES	YES	
Downsizing	no	no	no	no	no	no	
Reengineering	no	no	no	no	no	no	
TQM	YES	no	no	YES	no	no	
Simultaneous Improvement in cost/quality/ service	2	0	2	0	2	2	
Close to Customer	2	2	2	2	2	2	
Closer to Suppliers	1	1	0	0	0	0	
Technology for Strategic Advantage	0	0	0	0	0	2	<- Info. T
Flatter/less compartment. organizations	2	2	0	2	0	0	
Innovative Human Resource Pol.	2	2	0	0	0	0	
Rating on stage of development	3	2.3	2.3	2.3	2.3	3	
# of Employees	7580	7471	7414	7522			
mWh sold							
mWh sold/ Employee							
Price	5.1412		Price Change (1989-1994)			5.7071	
Price/Region	95.8%		$\boxed{11.0\%}$			101.2%	
Dominant Theme	as Premiere Energy Company	NSP is People Working for You	Working for its Customer s	Energy to Make Things Better	Energy Provider of Choice	NSP Is Energy	
	89-1221	90-1294	402	598	814	1098	

UTILITY:	PHILADELPHIA ELECTRIC						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	no	no	no	YES	YES	YES	
Downsizing	no	YES	YES	YES	no	YES	
Reengineering	no	no	no	no	YES	YES	
TQM	no	no	YES	YES	YES	no	
Simultaneous Improvement in cost/quality/ service	0	0	0	0	0	0	
Close to Customer	1	1	1	1	0	1	
Closer to Suppliers	0	0	0	0	0	0	
Technology for Strategic Advantage	0	0	0	0	0	0	
Flatter/less compartment. organizations	0	0	1	1	0	0	
Innovative Human Resource Pol.	0	0	(Sup. Dev. Acad.) 1	0	0	2	Incentive pay
Rating on stage of development	1	1.1	1.1	1.4	1.7	2	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	9.09388		Price Change (1989-1994)			9.84	
Price/Region	122.9%		8.2%			125.0%	
Dominant Theme	Environment	Year of Contrasts	Year of Solid Accomplishments	Continued Financial Recovery	Building a New Company	Challenging Environment	
						Outsourceing 1st to do so	
	89-1194	90-1157	92-1260	93-1246	810	1051	

UTILITY:	UNION ELECTRIC						
Year	1989	1990	1991	1992	1993	1994	1995
Evidence of:							
Recognition of Competition	NO DATA	no	no	YES	YES	YES	
Downsizing		no	no	no	no	no	
Reengineering		no	no	no	no	no	
TQM		no	YES	no	no	no	
Simultaneous Improvement in cost/quality/ service		2	2	2	2	2	
Close to Customer		2	2	2	2	2	
Closer to Suppliers		0	0	0	0	0	
Technology for Strategic Advantage		0	1	1	0	2	
Flatter/less compartment. organizations		0	1	1	1	0	
Innovative Human Resource Pol.		0	0	0	0	0	
Rating on stage of development		1	1	1.5	2.2	3	
# of Employees							
mWh sold							
mWh sold/ Employee							
Price	6.63965		Price Change (1989-1994)			6.2136	
Price/Region	100.7%		$\boxed{-6.4\%}$			96.9%	
Dominant Theme		Employee s	Exception al Year	Technolog y	Floods & Taxes	Competiti on	
	17% staffing cuts through 1994 (from 1987) all done through attrition						
	89-1470	90-1162	400	582	811	1051	

UTILITY:	SOUTHERN CALIFORNIA EDISON						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Southern California Ed.	CA 100	2362343	1	10.038	10.38	8.5	9.78
Totals		2362343	1				
Averages		10.03794	10.38	8.50	9.78		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	AMERICAN ELECTRIC POWER						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Appalachian Power Co.	VA 53	546690	636704	4.5726	4.79	5.9	6.2
	VW 47	508797	582557	4.7973	4.98	4.8	5.25
Columbus Southern	OH 100	709103	936377	5.826	6.61	5.7	6.19
Indiana Michigan	IN 83	628154	726083	5.477	5.6	5.4	5.25
	MI 17	89792	154597	5.3482	5.81	6.8	7.09
Kentucky Power	KY 100	446081	250384	4.0839	4.19	4.8	4.26
Kingsport Power	TN 100	66893	81373	4.2051	4.35	5.4	5.23
Ohio Power	OH 100	1208477	1262271	4.3244	4.11	5.7	6.19
Wheeling Power	WV 100	84383	78205	4.3099	4.52	4.8	5.25
Totals		4288370	4708551				
Averages		4.823564	5.107553	5.4818	5.8248		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	TEXAS UTILITIES						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Texas Utilities Elec. Co.	TX 100	4051094	1	5.3378	6.67	5.7	6.42
Totals		4051094	1				
Averages		5.337778	6.67	5.70	6.42		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	UNICOM (COMMONWEALTH EDISON)						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Commonwealth Edison	IL 100	5653948	1	8.1765	7.92	7.5	7.41
Totals		5653948	1				
Averages		8.176467	7.92	7.50	7.41		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	PACIFIC GAS AND ELECTRIC						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Pacific Gas and Electric	CA 100	5939474	1	8.7088	10.55	8.5	9.78
Totals		5939474	1				
Averages		8.708844	10.55	8.50	9.78		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	THE SOUTHERN COMPANY						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Alabama Power	AL 100	2089486	913146	5.6795	6.93	5.6	6.69
Georgia Power	GA 100	3207699	1180358	6.1459	7.53	6.4	7.72
Gulf Power	FL 100	408934	252598	5.3984	6.73	7	7.78
Mississippi Power	MS 100	338446	124257	5.0364	6.46	6.2	7.06
Savannah Electric & Po	GA 100	180409	90978	6.907	7.01	6.4	7.72
Totals		6224974	2561337				
Averages		5.901969	7.166819	6.16	7.3267		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	DUKE POWER						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Duke Power	NC	2249720	2609858	5.7303	5.76	6.2	6.62
	SC	964530	1057007	5.3648	5.21	5.6	5.67
Nantahala Power & Light	NC 100	42337	51391	6.0295	6.17	6.2	6.62
Totals		3256587	3718256				
Averages		5.625926	5.609316	6.02	6.3499		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	FPL GROUP						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Florida Power & Light	FL 100	4677695	1	7.3907	6.85	7	6.96
Totals		4677695	1				
Averages		7.390689	6.85	7.00	6.96		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	ALLEGHENY POWER SYSTEM						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Monongahela Power	WV 91	369291	473489	4.58	5.48	4.8	5.25
	VA 9	0	38628	0	5.54	5.9	6.19
Potomic Edison	MD 65	281727	379639	4.1075	5	6	7.03
	WV 18	93951	124075	5.54	5.89	4.8	5.25
	VA 17	82543	126914	5.2431	6.32	5.9	6.2
West Penn	PA 100	658332	921388	4.4274	5.47	7.4	7.87
Totals		1485844	2064133				
Averages		4.520341	5.464669	6.24	6.8229		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	ENTERGY						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Arkansas Power and Light	AK 100	974589	1169101	7.0257	7.38	6.4	6.35
Mississippi Pow. & Li.	MI 100	657718	797651	7.4683	7.61	6.2	7.06
Louisiana Power and Light	LA 100	1369429	1626496	5.3843	5.6	6	6.05
New Orleans Public Service	LA 100	368809	388697	7.1001	7.2	6	6.05
Gulf States Power	LA 56	0	961059	0	5.93	0	6.05
	TX 44	0	698019	0	5.46	0	6.52
Totals		3370545	5641023				
Averages		6.453318	6.402269	6.15	6.3131		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	DOMINION RESOURCES						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Virginia Power	VA 95	3109406	0.95	6.145	6.51	5.9	6.42
	NC 05	145394	0.05	6.1119	6.51	6.2	6.62
Totals		3254800	1				
Averages		6.143552	6.51	5.91	6.43		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	PACIFICORP						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Pacificorp	UT 33	698842	33	5.762	5.2	5.8	5.36
	OR 30	553550	30	4.6959	4.8	4.3	4.6
	WY 18	285234	18	3.7643	3.74	4.3	4.26
	WA 9	138317	9	4.3513	4.49	3.5	4.02
	ID 7	110730	7	3.6521	3.99	3.8	4
	MT 2	34383	2	4.3709	4.51	4.1	4.51
	CA 2	51484	2	7.303	7.18	8.5	9.78
Totals		1872540	101				
Averages		4.930415	4.699406	4.88	4.7952		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	CONSOLIDATED EDISON						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Consolidated Edison	NY 100	4138323	1	11.846	13.2	8.9	10.92
Totals		4138323	1				
Averages		11.84591	13.2	8.90	10.92		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	NIAGARA MOHAWK						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Niagara Mohawk	NY 100	2236309	1	6.69	9.38	8.9	10.92
Totals		2236309	1				
Averages		6.69	9.38	8.9	10.92		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	NORTHERN STATES POWER						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
NSP-- Minnesota	MN 89	1157297	1436997	5.1175	5.69	5.3	5.63
	ND 06	81375	96557	4.974	5.45	5.7	5.77
	SD 04	55028	73059	5.5844	6.03	6	6.19
NSP - Wisconsin	WI 97	223786	272796	5.1901	5.78	5.4	5.46
	MI 03	7359	8792	5.9113	6.38	6.8	7.09
Totals		1524845	1888201				
Averages		5.1412	5.707098	5.37	5.6411		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	PHILADELPHIA ELECTRIC						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Philadelphia Electric	PA 100	2912032	1	9.0939	9.84	7.4	7.87
Totals		2912032	1				
Averages		9.09388	9.84	7.40	7.87		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

UTILITY:	UNION ELECTRIC						
Operating Company	State/%	Revenue	Revenue	Price	Price	State Price	State Price
		1989	1994	1989	1994	1989	1994
Union Electric	IL	170211	12	4.7558	4.26	7.5	7.41
	MO	1632372	88	6.8361	6.48	6.5	6.28
Totals		1802583	100				
Averages		6.639652	6.2136	6.59	6.4156		
		Average Rate 89	Average Rate 94	Ave local rate 89	Ave local rate 94		

Appendix D
Porter's Entry Framework

Any effort to make cheap power available to manufacturers in this State is one which should be welcomed and encouraged in every way consistent with the public interest.[1]
-- Massachusetts Board of Gas and Electric Light Commissioners (1907)

D.1 OVERVIEW OF A DECISION WHETHER OR NOT TO ENTER A MARKET

The framework is based upon Porter's Chapter 16, and includes parts of other chapters. Porter states, "The economics of entry rests on some fundamental market forces that are operating whenever entry occurs. If these market forces work perfectly, in an economists sense, *then no entry decision can ever yield an above-average return on investment.* This startling statement is the key to understanding the economics of entry." As a result, one seeks to enter where there are market imperfections.

A potential entrant must balance:
(1) The investment costs to be in the new business, such as investment in manufacturing facilities and inventory;
(2) The additional investment required to overcome structural entry barriers, such as brand identification and proprietary technology;
(3) The expected reaction of incumbent firms (in the form of retaliation); and
(4) The expected cash flows from being in the business.

Frequently unanticipated caveats include:
- The existence of subtle barriers to entry (brand name recognition, access to distribution, etc.);
- The effect on the supply/demand balance of the entrant's new capacity; and
- The reactions of existing firms.

D.2 ANALYTICAL PROCESS

The analytical process is as follows.

D.2.1. Identify Target Industries (in this case locations)
- Industry is in disequilibrium;
- Slow or ineffectual retaliation by incumbents;
- Firm has lower entry costs than other firms;
- The firm has distinctive ability to influence the industry structure;
- There will be positive effects on a firm's existing businesses.

D.2.2 Perform a full structural analysis

D.2.3 Explicitly balance the four aforementioned parts and answer questions regarding the bullet points.

D.2.4. Look at compatibility with a generic concept for entry.

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[1] Cited in Wilcox, 1910, 148.

Appendix E
Generation Entry Results

That transmission remains a natural monopoly neither requires nor justifies a departure from microeconomic principles.[1]

-- Alfred F. Mistr, Jr. (1996)

E.1 Retail (Merchant) Plant Analysis

E.1.1 Profile of Scenarios Considered For Merchant Retail Wheeling Plant

POTENTIAL COMPETITORS

- Utilities
  - (a) Low cost/high cost
  - (b) competitive/non-competitive mind-set

- New Entrants
  - (a) low interest area/high interest areas
  - (b) aggressive/passive

POTENTIAL CONSUMERS

- Residential
  - growing/constant/declining population

- Commercial
  - Industrial
    - (a) electricity intensive/non-intensive
    - (b) highly profitable/struggling
  - Non-industrial

- Satisfied/unsatisfied with current utility

POTENTIAL REGULATORY SCHEMES

- Consumer flexible/fixed (i.e. easy to change suppliers vs. hard to change)
  (instantaneous purchases vs. bilateral)

CURRENT POSITION

- What other generation facilities do you own in the region?

REGION COST STRUCTURE

- High/low construction costs
- High/low electricity prices

AVAILABLE CAPACITY IN REGION

- Surplus/Shortage of capacity?

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[1]Mistr, 1996, 33.

E.1.2 Structural Analysis Of Potential Retail Plant Environment

CRITERIA AND ANALYSIS	VALUE	DATA NEEDED
I. THREAT OF ENTRY A. Barriers to Entry		
(1) *Economies of scale* - • There might be some economies of scale in the retailing process, such as in looking for customers, advertising, and handling bills, etc. Therefore, it would be desirable to build a merchant plant in an area where one could sell a considerable amount of power. • The market structure would make a difference. If one is selling to an aggregator, rather than soliciting customers directly, then there will be fewer costs (which would minimize the effects of scale economies.) • There may also be a flexibility scale advantage - there is a wider variety of ways to serve customers with 2000 MW of production than 100.	II (the $ amounts involved are likely to be relativel y small, however)	Where are other plants? Market structure
(2) *Product Differentiation* - • In order to create a differentiated electricity product, it is likely necessary to have multiple plants. Therefore, locations in a region where there are already plants would be desirable. Without a number of plants in service, the existing utility has an advantage here. • It should be noted that Porter defines product differentiation in terms of brand identification and customer loyalty... With that definition, locating in an area where the local utility has developed negative "brand recognition" would make potential customers less concerned about entrusting their electrical needs to a "newcomer." Look for areas where there are customers who are significantly displeased with the local utility and are specifically looking for alternatives. • If one is an established IPP, locating in an area where one has already been recognized as a solid producer, such as Makowski in New England, would take advantage, at least somewhat, of Porter's product differentiation objectives.	I I II	Where are other plants owned? Surveys of utility customers - service ratings. Harder to measure - respect within local community - especially business community.
(3) *Capital Requirements* - • Some areas have higher construction costs than others. Look for places where the costs are high - or are at least far from low construction cost areas (so that any differences in capital cost are offset by transmission inefficiencies). • Location with respect to important infrastructure, such as transmission system (less significant) and natural gas pipeline (if CCGT) is important.	II II	Cost data for other plants in regions. General construction cost data (to protect against extreme plant cost cases) Locations of infrastructure

(4) *Switching Costs* - The industry structure, regulated by the states, could be the source of significant switching costs or at least barriers to switching. For example, how stranded investment is handled could be very crucial. Look for places where fixed switching charges are not assessed up front. If switching charges are implemented, perhaps look for a place where they are charged every time a change in generators is made, it might be better to be the first merchant IPP, so that those who want to switch to an IPP do so, but have a charge to pay if they leave you.	I	Rules promulgated by PUCs.
(5) *Access to Distribution Channels* - In all states, currently, this is a fundamental barrier to entry. One could only conceive of building a plant where the PUC is considering, or already has, changed the rules regarding direct sales to consumers.	I	Rules or deliberations of PUCs
(6) *Cost Advantages Independent of Scale* - (a) Proprietary Product Technology - presumably, this should not be a problem as, with the changing of the economies of scale, existing firms will not have an advantage.	III	???
(b) Favorable Access to Raw Materials - will it be possible to get fuel easily?	II	Fuel supply
(c) Favorable locations - are there any economically desirable places to build a plant?	III	Zoning rules Locations of transmission lines and fuel supplies.
(d) government subsidies - Actually, government mandated subsidies FROM utilities could be a barrier to utility competition. Looking for places where QF contracts are being upheld and/or other policies where utilities are used as vehicles for public policy will weaken their competitiveness.	II	Details of competition rules (PUC decisions)
(e) Learning or Experience Curve - The history of the NUG business has shown that experience is not an overwhelming factor in the ability to run a reliable plant - hence this should not be a barrier to entry.	III	Reliability data of plants
(7) *Government Policy* - Clearly, this is a fundamental barrier to entry. Look for locations where the PUC is considering (or has already implemented) changes in direct access regulations.	I	PUC policies or deliberations

B. Expected Retaliation The electric power industry, in general, has many of the characteristics of one that is ripe for retaliation: slow industry growth, established firms with a commitment to the industry, and firms with established resources to fight back. However, given the desire to stimulate competition, PUCs will likely watch closely to make sure it is not squelched. However, differences in oversight will mean differences in the ability to retaliate.	II	PUC rules on competition.
C. Entry Deterring Price Given the lower costs of the new technologies, the existing utility should not be able to (at least economically) charge an entry deterring price. Certainly this will be true in regions that are near or above the national average in terms of current prices.	III	Current regional costs.
D. Properties of Entry Barriers		
(1) *They change for fundamental reasons* - we are seeing this in electric power, where the exclusive franchise concept is diminishing - in fact, this change in entry barriers makes this discussion even possible.	I	PUC Decisions/deliberations
(2) *They change for company strategic decision reasons* - In some cases, the utility may decide to abandon the generation business altogether. This would bring a rush of new entrants - creating an unstable market - but probably one with opportunity.	II	Stated intentions of executives Utility decisions
(3) *Resources allow overcoming of entry barriers* - - once again, the newer, more efficient technologies allow this to happen. The current utility generation mix will impact the benefits of this barrier-ameliorator.	II	Utility cost structure
E. Experience and Scale As Barriers - Limits		
(1) *Limit product differentiation* - If a utility has few plants, this might be true, otherwise, many big plants are an advantage.	II	# of plants operated by utility
(2) *Technological change punishes* - definitely true - extent will vary by region. (Stranded Investment)	I	Utility cost structure
(3) Impacts Mind-set - There are still some utilities that don't understand the competition thing.	I	Statements of utility executives
F. Nullification of Experience Barriers		
(1) *Process innovations leading to a new experience curve* - This is true in the utility industry, but it is probably pretty universally true.	III	
(2) *Low cost through experience may cost product differentiation* - the ability to differentiate will probably increase with experience.	III	
(3) *Multiple firms using the experience approach may prove fatal* - Avoid areas where a multitude of firms will be entering with the hopes of garnering market share, rather than short-terms profits, in order to "learn."	II	Intentions of potential competitors

(4) *Aggressive pursuit of cost declines through experience may draw attention away from developments* - Look for regions where utilities are still focused on improving big "old style" plants and seem oblivious to the new technologies.	I	If such utilities exist - then go after them!

B. INTENSITY OF RIVALRY AMONG EXISTING COMPETITORS 1. Intensity is caused by:		
(1) *Numerous or Equally Balanced Competitors* - Currently there are really no competitors anywhere. This will mean that whenever competition comes into being, it will be the established firm versus a variety of others. While very stable now, more imbalance will occur when new firms come in --> intense competition. Look for markets with fewer potential entrants.	I	Potential entrants - but ?how does one know the intensity of interest in entering the market?
(2) *Slow Industry Growth* - competition will be less intense in markets that are growing.	I	Data on load growth by region
(3) *High Fixed or Storage Costs* - this is a problem everywhere.	III	
(4) *Lack of Differentiation or Switching Costs* - Look to areas where (1) You might be able to create a differentiated product because of owning several generation units and (2) away from areas where there will be a substantial "transition charge" for those leaving the utility.	I	Location of other assets Rules of the PUC
(5) *Capacity augmented in Large Increments* - Larger markets will be able to absorb the onslaught of new generators better than smaller control areas.	II	Energy supply within a control area or region.
(6) *Diverse Competitors* - Look for areas where the competitors will be relatively homogeneous. Presumably there will be the utility in one category - it would be desirable if the new entrants were relatively similar (as opposed to some seeking to build market share, others who want to develop a new form of energy, others who want to make a quick buck.)	II	Profile of probable competition.
(7) *High Strategic Stakes* - Look for areas where the utility does not view generation as vital to the essence of being a utility.	II	Attitudes of utility management
(8) *High Exit Barriers* - This will presumably be true in all places, because of the specificity and high fixed cost of the plants. Are there areas, though, where more of the plants have been paid off (clearly stranded investment is not equally spread). The downside of this might be that in such areas, a utility may be more willing to close the inefficient plant in favor of building another, more efficient one (maybe?)	II	Degree to which plants must still be paid for within a region.
B. <u>Shifting Rivalry</u> - since a retail market has yet to exist, let us not examine this characteristic now.	III	

C. Exit Barriers and Entry Barriers - look for areas where entry barriers are high (yet can be cleared by the particular investor) and exit barriers are low. Look for areas where regulations make entry more difficult (environmental laws/stranded investment payments). This is likely not the case with CCGT technology.	II	Regulations of an area
III. PRESSURE FROM SUBSTITUTE PRODUCTS		
• There seem to be two ways by which a substitute could be found: self-generation and DSM. Look for areas where: (1) for large numbers of customers it would not be economically feasible to self-generate, and/or (2) where DSM programs have been effective at taking care of the easy energy savings.	I	Status of DSM in area Load size of customers
IV. BARGAINING POWER OF BUYERS A. Buyers are powerful if...		
(1) *Concentrated or purchases large volumes relative to seller sales* - Look for areas (or target buyers) who would compose a small fraction of ones customers.	III	This more of a marketing strategy rather than a location one.
(2) *The products it purchases from the industry represent a significant fraction of the buyer's costs or purchases* - look for areas where the industry tends to be non-intensive.	I	Demographics of local industry
(3) *The products or purchases from the industry are standard or undifferentiated* - Build in areas where one can create product differentiation - specifically because one owns other plants in the region.	I	Location of other assets
(4) *It faces few switching costs* - Look for states where the PUC has inserted costs for switching suppliers.	II	PUC regulations
(5) *It earns low profits* - Look for areas where the economy is robust. For example, at the present time avoid areas where defense is a large % of industry. The difficulty in this, though, is that one is making a 20 year investment. "Massachusetts Miracles" come and go often within that period.	II	Profiles of incumbent businesses and their profitability.
(6) *Buyers pose a credible threat of backward integration* - Avoid areas where price-sensitive customers are large enough buyers to consider self-generation - or potentially better yet, co-opt them in the beginning and build cogenerator with them.	I	Size of price sensitive customers
(7) *The industry's product is unimportant to the quality of the buyer's products or services* - Look for areas where electric quality is important. The downside of this is that the incumbent utility will probably take the position of, "why trust your service to a new company when we've been around for 100 years."	III	

(8) *The buyer has full information* - Look for areas where the set-up is a longer term contract, with more proprietary economic dispatch data. Avoid electronic bulletin boards where buyers can purchase energy easily.	I	Structure of deregulation
B. Altering Buyer Power		
Buyer selection - choosing a customer base, such as targeting of customers with little power to influence it adversely, is one way that buying power can be altered by the supplier.	III	This would be more of a target marketing approach than a location decision basis as such customers exist in abundance nearly everywhere.
V. BARGAINING POWER OF SUPPLIERS[2] Suppliers Can Exert Bargaining Power if...		
(1) *It is dominated by a few companies more concentrated than the industry it sells to* - Look for regions where there is an active market in natural gas supply.[3]	I	Competition among fuel suppliers.
(2) *It is not obliged to contend with other substitute products for sale to the industry* - The degree of leverage vis-a-vis other fuel sources depends upon the flexibility that one builds into their plant. Building one that can run on either gas or coal would provide a generator with more leverage.	I	Your choice of plant type.
(3) *The industry is not an important customer of the supplier group* - Look for areas where the reliance on natural gas in other aspects of society is lower than usual. Or, perhaps a better indicator of this is the excess capacity of pipelines.[4]	I	Excess capacity of pipeline.
(4) *The supplier's product is an important input to the buyer's business* - Clearly fuel is an important input into power plants. Unless one builds a multi-fuel plant or signs a long-term contract, this would be a large source of leverage for the supplier.	II	The characteristics of the plant and contractual agreements.
(5) *The supplier group's products are differentiated or it has built up switching costs* - This once again is a function of one's plant design. A multi-fuel plant would reduce switching costs (make switching a possibility).	III	The characteristics of the plant.

[2]For the purpose of this discussion, we will limit suppliers to fuel supply. In the case of capital equipment, there will be little, if any, temporal difference in suppliers.

[3]As important as the competition between suppliers that occurs is the general temporal differences between states. In the Continental United States the average price charged to electric utilities ranges from $.97 per thousand cubic feet to $5.80. Source: Energy Information Agency, December 1995, 58.

[4]Since a power plant would likely sign a long term agreement for some or all of its fuel supply, the current excess capacity may be a sufficient indicator of the importance of a plant as a customer. It is easier to predict this indicator for natural gas supply than for coal supply.

(6) *The supplier group poses a credible threat of forward integration* - Look for areas where the fuel supply is dominated by relatively passive firms. For example, Makowski (U.S. Gen.) in the Northeast would be an example of an area to avoid.[5]	I	IPP activity of dominant fuel suppliers.
VI. GOVERNMENT AS A FORCE IN INDUSTRY COMPETITION		
• As has been seen throughout, the local government is one of the most important factors in determining a plant location. This is true because the industry we are attempting to differentiate, is fundamentally similar - it is only the buyers, sellers, and the regulatory environment which makes a difference from location to location.	I	

E.1.3 Question: From the Viewpoint Of A Potential New Merchant Plant Operator, What Characteristics of a Location For a Retail Plant Would Be Favorable?

IDENTIFY TARGET INDUSTRIES (or in this case, locations)		
CRITERIA AND ANALYSIS	**VALUE**	**DATA NEEDED**
1. Industry is in Disequilibrium -		
(a) *New Industries* - This whole discussion is completely moot unless the local regulatory commission intends to, and eventually does, open up the industry to retail competition.	I	Intentions/Decisions of the PUC
(b) *Rising Entry Barriers* - Below is the criteria that Porter uses to judge the wisdom of early entry. They all appear to be more characteristic of the industry in general, rather than concepts that could vary (or at least predictably so) as a function of location. Early Entry is desirable when: • Image and reputation of the firm are important to the buyer - It's hard to know how important this will be. • Early entry can initiate the learning process (important when learning curve is significant) - the learning curve probably is not too significant. • Customer loyalty will be great - this probably will not be true. • Absolute cost advantages can be gained by early commitment to resources - with natural gas prices at such low levels, it is probably advantageous to sign long-term contracts now. Hence, the ability to obtain a guaranteed contract with a provider might be the only regionally segmented characteristic.	II	Ability to negotiate with natural gas suppliers.

[5]From the discussion in this section it should be clear that: (1) because of the importance and significant cost of fuel; and (2) high switching costs -- especially if one does not build a plant that is capable of burning multiple kinds of fuel -- it is important to protect oneself from supplier abuse by signing long-term contracts for fuel supply. Doing so would significantly limit the potential for supplier abuse.

Early Entry is Risky when: • Early Competition and Market segmentation are on a basis that will be different later in the development of the industry - This is probably true - although I don't know if "wrong" skills would be developed in the process. • Costs of opening up a market are great (customer information, regulations) - This is probably a characteristic of the retail market. • There will be costly competition with small firms while larger formidable ones will come in later - with the economies of scale - and with the potential for distributed generation, the inverse is probably true • Technological change will make early assets obsolete - perhaps eventually, but there are many current assets that will become obsolete first.		
(c) *Poor Information* - If one knows a lot about a specific area, it might have an advantage in appraising the potential market and knowing how to go about with competition (i.e. the local mind-set).	I	One's knowledge of an area
2. Slow or Ineffectual Retaliation - not included below is the impact that regulators could have on preventing retaliation.	I	Regulators actions and statements
(a) *Incumbents cost of effective retaliation outweighs the benefits* - Look for areas where the utility has a high cost structure and therefore, simply cannot afford to retaliate.	I	Cost structure of utility
(b) *There is a paternal dominant firm or tight group of long-standing leaders* - Look for areas where the utility is not yet in a competitive mind-set.	I	Statements/actions of management
(c) *The entrant can exploit conventional wisdom* - If there is a utility that is still in the mind-set of the 1970s and 1980s, this would be a good place to compete.	I	Statements/actions of management
(d) *Incumbent's Costs of responding are great given the need to protect their existing businesses* - if the utility has a good reputation, its attempts to "squash" the new competition may be taken badly by the public - thus losing an advantage. (This happened to AT&T)	II	Current feelings toward utility
(3) Firm has lower entry costs than other firms - If one already operates a plant in a region, one might be able to enter less expensively.	II	Other potential entrants
(4) The firm has a distinctive ability to influence the industry structure - Look for situations where a utility is seeking a NUG competitor/partner. The Destec-PG&E deal would be a great example of this.	I	Feel for utilities' strategies for dealing with competition
(5) There will be positive effects on a firm's existing businesses - If one owned a potential cogen site, this would be an asset to explore the use of.	I	What other businesses own.

From this, we see that potentially desirable areas would include:
• Those where the regulatory body is open to retail competition;
• Those where a business currently operates: for potentially 3 reasons
  - potential cogeneration
  - extra knowledge about the region and its processes
  - product differentiation through other plants;
• Those where the utilities have a high cost structure and/or are not prepared for a competitive marketplace;
• Those where fuel supply competition is high (or where fuel prices are generally low); and;
• Those where an early entrant might be able to become part of an interesting market structure.

E.1.4 Structural Analysis Results

Let us now look explicitly at the important criteria, based upon Porter's Five Competitive Forces:

E.1.4.1 Threat of Entry

The threat of entry is higher with fewer barriers to entry. Hence look for areas where:
• One can create a differentiated product.
• The local utility is not in good standing with consumers.
• The PUC has given little, if any, stranded investment relief to the utilities.
• The new market structure makes it harder for customers to switch from one company to another.
• Willingness of the PUC to even allow retail sales.
• Utility operating costs are high (less able to meet prices - although they will also likely be less willing to abandon market).

E.1.4.2 Intensity of Rivalry Among Suppliers

Look for areas where:
• There are likely to be few entrants.
• Demand is growing relatively quickly (so that new capacity can be absorbed -- at least partially).
• One can create a differentiated product.

E.1.4.3 Pressure From Substitute Products

• Past DSM programs have taken out much of the "easy" potential energy savings for customers.
• Self-generation is a viable option for few customers.

E.1.4.4 Bargaining Power of Buyers

• Areas where industry is less electricity intensive would have a lower price sensitivity and would therefore be less willing to leave you quickly (even though you may need that as an entry strategy), since highly price sensitive customers will likely bolt more quickly for a small price differential.
• Attempt to co-opt large, price-sensitive customers into a cogeneration project.
• Avoid market structures where the buyer knows and/or is able to get his hands on the money from market inefficiencies.
• Create a differentiated product.

E.1.4.5 Bargaining Power of Suppliers

Look for areas where:
• Fuel prices are low and/or there is intense competition among gas sellers.
• Gas sellers are not interested in forward-integration.
• Much of the supplier's bargaining power can be eliminated through allowing yourself flexibility in fuel, and locking in a long-term contract.

E.1.5 Balance of Four Important Points

When entering, one must balance:
(1) the investment costs to be in the new business, such as investment in manufacturing facilities and inventory

• Look for locations where the cost of construction is low and economic accessibility to resources (natural gas, transmission grid) is high.
• Look for areas where the regulatory climate is less intensive - specifically environmental regulation.

(2) The additional investment required to overcome structural entry barriers, such as brand identification and proprietary technology
• Look for areas where customers are in open revolt against their local utility and avoid areas where the utility is highly respected.

(3) expected reaction of incumbent firms (in the form of retaliation)
• Look for areas where the utility is either constrained from retaliation by regulation or economic necessity.

(4) expected cash flows from being in the business.
In locations where the price of electricity is higher relative to the rest of the country, several positive factors will occur. (This price gradient item doesn't seem to fit in anywhere else.) (1) One's lower-priced, new technology plants will have a higher profit margin, (2) its low price will be even more attractive to consumers, and (3) one will be able to survive any price war which might develop because so much damage will have to taken by the utility that it would probably not fight.

Frequently unanticipated caveats include:
(1) *Subtle barriers to entry (brand name recognition, access to distribution, etc.)*
• Avoid areas where the local utility might retain an ability to tie-up distribution, etc., due to insufficient regulatory protection mechanisms.
• Avoid areas where the utility is well-liked.

(2) *Effect of entrant's new capacity needs to be considered.*
• Areas where one's new capacity will barely be noticed in the larger scheme of things will help to ensure that no radical price changes occur to do entry, and its impact on the supply-demand equilibrium.

(3) *Reactions of existing firms*
• Look for an area in which the utility is not in a position to have a significant capacity expansion, and where its financial situation will not allow it to perform massive cost-cutting or promotions.

E.1.6 Generic Strategies for Entry

(1) Reduce Product Costs		
(a) New Process Technology - Look for regions where utility power is expensive due to use of old technologies.	I	Current regional power costs
(b) *Larger plant* (in order to reap economies of scale) - this is the opposite of what is needed in the industry today.	III	
(c) *More modern facilities* - Once again, look for areas where the utility has older, less efficient plants.	I	Age and efficiency of plants
(d) *Shared activities with existing businesses that yield a cost advantage* - Look for areas where there might be significant potential cogen sites.	I	List of cogenerators Estimation of industrial sites that would be good for cogeneration.
(2) Buy In with Low Price - Presumably this will be the strategy wherever one enters (and fortunately, due to new technology, there need not be a sacrifice of short run profits - in fact profits may be higher in short-run than in long-run.)	III	
(3) Offer a Superior Product, Broadly Defined - In order to attempt this strategy, it would be necessary to locate in a region where one owns multiple plants in order to offer a differentiated product.	II	Location of other generators

(4) Discover a New Niche - Look for areas where there are significant classes of customers with similar needs that could be met by a generator of the size one is thinking of building?	II	Profile of potential customers
(5) Introduce a Marketing Innovation - Are there new ways that the entrant could bundle generation based upon the capabilities of the firm and the needs of potential customers in the region?	III	Location of assets Competencies of entrant Needs of consumers
(6) Use Piggybacked Distribution - If the potential entrant runs other businesses, locate in an area where it has multiple current customers/suppliers with whom it has a good relationship.	II	location of customers/suppliers

E.1.7 General Conclusions

Based upon this process, criteria for determining a preferred area for building a merchant retail plant are as follows:

- Before anything else, local regulators must be open to allowing retail competition.
- The local utility has many dissatisfied customers, especially due to high prices.
- The local utility is not prepared for competition, it has not undergone the changes necessary to compete effectively, and is saddled with old, inefficient plants.
- Stranded investment costs are not so high that significant relief will be sought (which could be a barrier to entry), yet not so low that the utility can enter into the market unscathed.
- The concentration is likely to remain high (few new entrants will emerge).
- A potential exists for a significant cogeneration facility.
- The regulatory structure allows for the producer, not the consumer, to retain any benefits from economic inefficiencies.
- There is a possibility for creating product differentiation due to the location of other assets.
- Demand is growing relatively quickly.
- There are significant potential customers who are not hyper-price sensitive (they will be willing to jump at significantly lower rates, but will not, in turn, dump you for marginal savings.)
- The customer base is likely to be somewhat diverse - avoid dependence on one customer or one large industry.
- Avoid areas where "easy" energy savings can be made - DSM, etc. - by potentially prime customers.
- Look for opportunities to create new market structures.
- Look especially hard at regions that management knows well and has business contacts.

E.2 WHOLESALE PLANT ANALYSIS

E.2.1 Profile Of Scenarios Considered For Wholesale Bidding Situation

ASSUMPTION
* The addition of wholesale capacity will be brought about through a competitive bidding auction which can include the utility, IPPs, or DSM programs.

CURRENT POSITION OF ENTITY IN QUESTION
- What other generation facilities do you own in the region?

BIDDING RULES
- Purely least cost/other items considered such as past experience, product differentiation.
- Are some fuel sources preferred or restricted (for environmental or fuel diversity)/strict, traditional business criteria are only considerations
- Quantity of power for bid (single or multiple contracts available)

OTHER COMPETITORS FOR BID
- Others intensely want to win bid for variety of reasons (may not be profit-maximizing)/more "rational" economic bidders
- Many/few bidders in past/anticipated
- How well established is the bidding process - new/old

REGION COST STRUCTURE
- High/low construction costs
- High/low electricity prices

MISC.
- Potential for cogen sites

E.2.2 Structural Analysis Of Potential Wholesale Plant Environment

CRITERIA AND ANALYSIS	VALUE	DATA NEEDED
I. THREAT OF ENTRY A. Barriers to Entry		
(1) *Economies of scale* - There might be some economies of scale in the bidding process. The cost of bidding will be less if one has bid in a region before, or if there are multiple bids out for the contract in consideration.	II (small $ compared to cost of project)	Specifications for bid History of bidding process
(2) *Product Differentiation* - Per our last discussion... • In order to create a differentiated electricity product, it is likely necessary to have multiple plants serving an area. Depending upon the needs of the utility, it might be advantageous in the bidding process to submit one with such flexibility. • It should be noted that Porter defines product differentiation in terms of brand identification and customer loyalty... With that definition, locating in an area where one has developed a reputation as a reliable supplier would be helpful if the bidding process is not a pure "low cost" bid.	I II	Owned plants in area. Needs of utility (base load vs. peak plant) Bidding details Reputation (I guess one would know that from experience)
(3) *Capital Requirements* - • Some areas have higher construction costs than others. If one has sufficient capital, look for places where the costs are high - or are at least far from low construction cost areas (so that any differences in capital cost are offset by transmission inefficiencies). in order to eliminate more poorly capitalized competitors. • Location with respect to important infrastructure, such as transmission system (less significant) and natural gas pipeline (if CCGT) is important. • What (if any) financial structure requirements exist - finance structures, etc.	II II II	Cost data for other plants in regions. General construction cost data (to protect against extreme plant cost cases) Location of Infrastructure Specifications of RFP

(4) *Switching Costs* - The buyer is obliged not to switch - and even so, this is not a relevant concept in the bidding process.	III	
(5) *Access to Distribution Channels* - This should not really be an issue if one is planning on selling only to the local utility. However, if the ideal plant site for a bid is outside the utility's territory, or if one anticipates substantial wholesale wheeling, then it would be desirable to locate in a region where the local utility's transmission policies and pricing are clear (and favorable.) Even though the FERC can mandate the wheeling, some utilities will have more (or less) favorable arrangements.	II	Intent of owners Filings with FERC
(6) *Cost Advantages Independent of Scale* - (a) Proprietary Product Technology - are there IPPs in a region that (a) are nurturing a new technology that is supported by those in charge of the bidding process, or (b) that offers an unbeatable low-cost supply? (b) Favorable access to raw materials - will it be possible to get fuel easily? (c) Favorable locations - are there any economically desirable places to build a plant? Do potential bidding competitors own prime spots? (d) government subsidies - once again, avoid situations where there are there competing technologies that are likely to be automatically chosen in order to promote their development. (e) Learning or Experience Curve - The history of the NUG business has shown that experience is not an overwhelming factor in the determination of ability to run a reliable plant - hence this should not be a barrier to entry.	I II II I III	Likely competition in region Details of fuel supply Zoning rules Locations of x-mission lines and fuel supplies. Land ownership of potential competitors Agreements with utilities/QF companies Reliability data of plants
(7) *Government Policy* - Are there any fuel diversity rules that will likely help or hurt a potential bid?	I	PUC policies or deliberations

B. Expected Retaliation • Retaliation is hard to predict in this bidding process where the market is quite fragmented. I suppose that if one were a utility from another part of the country, and one put in a bid for a plant in another part of the country, the powers that be in that area might try to bid on the next plant in the instigator's home territory - how likely that is, I don't know. And I'm not sure if this is really retaliation as Porter describes it (and one would have to be dominant in another market already.)	III	
C. Entry Deterring Price Look at the values of past winning bids: If they are low, unless something has changed - will they have a high enough return to justify the effort?	I	Past prices Significant events in industry/areas
D. Properties of Entry Barriers		
(1) *They change for fundamental reasons* - not relevant for competitive bid.	III	
(2) *They change for company strategic decision reasons* - not relevant for competitive bid.	III	
(3) *Resources allow overcoming of entry barriers* - not relevant for competitive bid.	III	
E. Experience and Scale As Barriers - Limits		
(1) *Limit product differentiation* - not relevant for competitive bid - if any advantage from product differentiation exists, it is with the firm that has a larger scale..	III	
(2) *Technological change punishes* - not relevant for competitive bid - since it is not competing against existing capacity - if it were (in retail case) then this is clearly a big consideration.	III	
(3) *Impacts Mind-set* - only relevant for competitive bid if none of the other bidders employ new technology - which is highly unlikely.	III	
F. Nullification of Experience Barriers		
(1) *Process innovations leading to a new experience curve* - This is true in electric power in general, probably not in a competitive bid.	III	
(2) *Low cost through experience may cost product differentiation* - product differentiation is not usually important in the wholesale market.	III	
(3) *Multiple firms using the experience approach may prove fatal* - Avoid bidding situations where several firms are trying to run many plants to gain experience.	II	Firms projected to enter bid Their strategies Their other locations

(4) *Aggressive pursuit of cost declines through experience may draw attention away from developments* - Look for areas where bidding is usually done by exotic energy production companies (if such areas are open to new, more conventional supplies as well), then those attempting to gain experience from exotic energy forms won't change to meet your new technology.	II	Firms that usually bid in an area Openness to "conventional" new technologies.
II. INTENSITY OF RIVALRY AMONG EXISTING COMPETITORS (will be high when:)		
A. *Numerous or Equally Balanced Competitors* - Presumably this will be the case for most bids - look for areas where there is less interest in competitive bids.	I	Past history of bidding process, # of bidders.
(2) *Slow Industry Growth* - Expanding markets will make each particular bid less important for those who are bidding - therefore look for areas with high growth.	I	Load growth for area.
(3) *High Fixed or Storage Costs* - This is true everywhere.	III	
(4) *Lack of Differentiation or Switching Costs* - This is generally a commodity situation.	III	
(5) *Capacity augmented in Large Increments* - This would actually be helpful to the bid, as there would be the potential for several winners.	II	Quantity of power needed
(6) *Diverse Competitors* - This isn't significant in the bidding process.	III	
(7) *High Strategic Stakes* - Avoid bidding in areas where a firm is placing a higher importance on winning the bid than making a near-term profit - (actually, it forgets about a profit on the project as a whole in order to establish itself as a player.	II	Intent of potential bidders. (hard to get)
(8) *High Exit Barriers* - Given that this is a fixed-term contract, I am unsure as to the relevancy of this point.	III	
B. <u>Shifting Rivalry</u> - It would appear that the IPP industry is in a period of consolidation (Makowski + U.S. Gen.) It would be best to target areas where the potential bidders seem solid, in terms of avoiding a shake-out, because new ventures might be more apt to want to expand at any cost.	II	Situation of Potential bidders
C. <u>Exit Barriers and Entry Barriers</u> - the objective is to look for areas where entry barriers are high (yet can be cleared by the particular investor) - this should deter many bidders. Environmental regulations would be an example. The exit barriers should not be an issue for a fixed contract.	II	Costs specific to a region

III. PRESSURE FROM SUBSTITUTE PRODUCTS		
• Potential competition would likely come from a low-cost DSM program. Avoid areas where low-cost DSM programs could undercut the bid price.	II	Cost of DSM programs in a region.
IV. BARGAINING POWER OF BUYERS A. Buyers are powerful if...		
(1) *Concentrated or purchases large volumes relative to seller sales* - Certainly in a competitive bid, this is the case everywhere. The buyers do hold most of the cards.	III	
(2) *The products it purchases from the industry represent a significant fraction of the buyer's costs or purchases* -	III	
(3) *The products or purchases from the industry are standard or undifferentiated* -	III	
(4) *It faces few switching costs* -	III	
(5) *It earns low profits* -	III	
(6) *Buyers pose a credible threat of backward integration* -	III	
(7) *The industry's product is unimportant to the quality of the buyer's products or services* -	III	
(8) *The buyer has full information* -	III	
B. Altering Buyer Power		
At this point in time, with many potential bidders, it is a buyers market.		
V. BARGAINING POWER OF SUPPLIERS[6] Suppliers Can Exert Bargaining Power if...		
(1) *It is dominated by a few companies more concentrated than the industry it sells to* - Look for regions where there is an active market in natural gas supply.[7]	I	Competition among fuel suppliers.
(2) *It is not obliged to contend with other substitute products for sale to the industry* - The degree of leverage vis-a-vis other fuel sources depends upon the flexibility that one builds into their plant. Building one that can run on either gas or coal would provide a generator with more leverage.	I	Your choice of plant type.
(3) *The industry is not an important customer of the supplier group* - Look for areas where the reliance on natural gas in other aspects of society is lower than usual. Or, perhaps a better indicator of this is the excess capacity of pipelines.[8]	I	Excess capacity of pipeline.

[6]See footnote 1.
[7]See footnote 2.
[8]See footnote 3.

(4) *The supplier's product is an important input to the buyer's business* - Clearly fuel is an important input into power plants. Unless one builds a multi-fuel plant or signs a long-term contract, this would be a large source of leverage for the supplier.	II	The characteristics of the plant and contractual agreements.
(5) *The supplier group's products are differentiated or it has built up switching costs* - This once again is a function of one's plant design. A multi-fuel plant would reduce switching costs (make switching a possibility).	III	The characteristics of the plant.
(6) *The supplier group poses a credible threat of forward integration* - Look for areas where the fuel supply is dominated by relatively passive firms. For example, Makowski (U.S. Gen.) in the Northeast would be an example of an area to avoid.[9]	I	IPP activity of dominant fuel suppliers.
VI. GOVERNMENT AS A FORCE IN INDUSTRY COMPETITION		
Unless one is running a renewable energy bid, as a potential supplier of low-cost energy, one wants a regulatory agency that will uphold the rights of the IPP, while at the same time, not interfere with the bidding process so that it is a price-drive decision-making process.	I	

From this we can see:
- Operating in an area where one already has facilities allows for product differentiation.
- There are some regions of the country where competition for bids is likely to be lower. Avoiding places such as California, for example, would probably be a wise strategy.
- Unless one wishes to bid with renewable fuels it is wise to avoid bids where such programs (or DSM) have historically been given preferential treatment.

E.2.3 Question: From The Viewpoint Of A Potential Bidder, What Characteristics Of A Competitive Auction For New Wholesale Capacity Would Be Favorable?

IDENTIFY TARGET INDUSTRIES (or in this case, locations)		
CRITERIA AND ANALYSIS	**VALUE**	**DATA NEEDED**
(a) *New Industries* - If a bid has never been put out in a state before, this provides the possibility of being the first one in and likely facing less competition (or at least none from those experienced in the process), however, it also poses many risks as to process. One should either have other businesses in a region or some other means of being familiar with the locality and its process.	I	Familiarity with locality

[9]See footnote 4.

(b) *Rising Entry Barriers* - None of these seem applicable Early Entry is desirable when: • Image and reputation of the firm are important to the buyer - in places where there is some "noneconomic" factors involved, early entry with subsequent successful implementation may be helpful for future bids. • Early entry can initiate the learning process (important when learning curve is significant) - this is not a huge consideration - although as Joe Kearney pointed out,[10] there may be some learning that occurs in the bidding process itself. • Customer loyalty will be great - not likely • Absolute cost advantages can be gained by early commitment to resources - probably not for future bid victories (which is what the potential benefit would be seen to be by Porter.) Early Entry is Risky when: • Early Competition and Market segmentation are on a basis that will be different later in the development of the industry - at least, theoretically, the contract should insulate the bidder from any changes - with the institution of retail competition, this would not be the case. (while potentially bid-specific in the long term - it is hard to predict where such would occur.) • Costs of opening up a market are great - not much marketing, etc. involved • There will be costly competition with small firms while larger formidable ones will come in later - competition will probably not slow for a while • Technological change will make early assets obsolete - should not be an issue with a fixed contract.	II III III III III III III III	Rules of the bidding process
(c) *Poor Information* - If one knows a lot about a specific area, a company might be able to tailor a bid to meet the specific needs/desires of a region and better understand the potential paybacks.	I	One's knowledge of an area
2. Slow or Ineffectual Retaliation (likely to occur if:)		
(a) *Incumbents cost of effective retaliation outweighs the benefits* - retaliation is not really relevant in a bidding situation.	III	
(b) *There is a paternal dominant firm or tight group of long-standing leaders -*	III	
(c) *The entrant can exploit conventional wisdom -*	III	
(d) *Incumbent's Costs of responding are great given the need to protect their existing businesses -*	III	
(3) Firm has lower entry costs than other firms - If one already has a plant in the region, or was one of a limited number of bidders in a past round, there might be a cost (and experience) advantage.	II	History of company Location of other plants History of biding

[10]"International Conference on the Future of Industry in Advanced Societies Conference Report," 6-7.

(4) The firm has a distinctive ability to influence the industry structure - If little bidding has been done in the past, this might be an opening for shaping of the structure and the potential for future bids.	II	History of bidding
(5) There will be positive effects on a firm's existing businesses - If one owns another business with a potential cogeneration site, this would be a chance to lower electricity rates for it, while making money elsewhere.	I	Other assets in the area

From this, we see that potentially desirable auctions would include:
- Those where a business currently operates: for potentially 3 reasons
  - potential cogeneration
  - extra knowledge about the region and its processes
  - product differentiation through other plants

E.2.4 Structural Analysis Results

Let us now look explicitly at the important criteria, based upon Porter's Five Competitive Forces:

E.2.4.1 Threat of Entry

- The ability to create a differentiated product may serve as a barrier to others.
- A propensity on the part of a regulatory commission to support certain types of generation technology will serve as a barrier.
- If an area has traditionally produced low bids, is there any reason to think that will change? - if not, then avoid.

E.2.4.2 Intensity of Rivalry Among Suppliers

- Areas where the load demand is growing allow for multiple winners
- Look for areas where the expected number of bidders is low.

E.2.4.3 Pressure From Substitute Products

- Avoid places where DSM is likely to be desired - either because of the bidding rules or because it might be economical (if little DSM has been done in an area.)

E.2.4.4 Bargaining Power of Buyers

- This is, inherently, a buyers market

E.2.4.5 Bargaining Power of Suppliers

Look for areas where:
- Fuel prices are low and/or there is intense competition among gas sellers.
- Gas sellers are not interested in forward-integration.

Much of the supplier's bargaining power can be eliminated through allowing yourself flexibility in fuel, and locking in a long-term contract.

From this, we see that potentially desirable auctions would include:
- There is the possibility of product differentiation
- DSM is not a strong substitute
- There are likely to be few bidders
- There is the possibility for multiple winners
- Pet energy projects are not important to those awarding the contracts

E.2.5 Balance of Four Important Points

With this information in mind, let us now examine the four points that Porter suggests be balanced.

When entering, one must balance:

(1) *the investment costs to be in the new business, such as investment in manufacturing facilities and inventory*

Look for an area where construction and fuel source acquisition will be relatively inexpensive.

(2) *The additional investment required to overcome structural entry barriers, such as brand identification and proprietary technology*

The biggest structural entry barrier is winning the bid.

(3) *expected reaction of incumbent firms (in the form of retaliation)*

As seen above, retaliation is not expected to occur anywhere (only perhaps in the most limited of situations)

(4) *expected cash flows from being in the business.*

Look for auction environments where existing prices for bids are high (and will continue to likely be high).

Frequently unanticipated caveats include:

• *subtle barriers to entry (brand name recognition, access to distribution, etc.)*

These should be marginal issues in a bid - if one has a good reputation, that can't hurt, however (and it may allow some financing and structural agreements that would not otherwise be possible.)

• effect of entrant's new capacity needs to be considered.

If one can enter a bid where it only captures a fraction of the total (there is more than one winner) there is likely to be less cut-throat competition

• reactions of existing firms

The definition of reaction of existing firms, at least as defined by Porter (i.e. promotions, advertising, temporarily lowered prices, wave of capacity expansion), appears to be applicable more to an ongoing competitive market, rather than a one-time shot. Hence, this variable is not significant.

E.2.6 Generic Strategies for Entry

(1) Reduce Product Costs		
(a) *New Process Technology* - Look for regions where other bidders use older technologies. (where this would be - I'm not sure!)	I	Likely bidder profile
(b) *Larger plant* (in order to reap economies of scale) - the amount of needed power will be stipulated, so sizes will be equivalent.	III	
(c) *More modern facilities* - they will all be brand new.	III	

(d) *Shared activities with existing businesses that yield a cost advantage* - Look for areas where there might be significant potential cogen sites.	I	List of cogenerators List of potential cogeneration sites
(2) Buy In with Low Price - This strategy presumably could be used anywhere - although the wisdom of it, on a fixed contract, is probably questionable.	III	
(3) Offer a Superior Product, Broadly Defined - Look for areas where one has a strong history of high reliability compared with competitors and the industry in the area in general.	II	History of company and region.
(4) Discover a New Niche - In a bid, the market is pretty much defined.	III	
(5) Introduce a Marketing Innovation - Makowski seems to have been somewhat successful at doing this, but I'm not sure how location-dependent it is.	III	
(6) Use Piggybacked Distribution - This isn't really a viable option given the constraints of the industry.	III	

E.2.7 General Conclusions

Based upon this process, criteria for deciding whether or not to enter a competitive auction are as follows.

- The number of expected bidders (the smaller the better)
- The number of expected "winners" (multiple are preferred)
- The knowledge of the local area and its processes (the more the better)
- The importance of DSM and renewable energy projects that may or may not be economical) in the eyes of those who make the final decisions (the less the better)
- The ability to create a differentiated product - likely based upon other generating assets in the region (the more the better)

A good competitive strategy is to do so through the construction of a cogeneration unit - either tied to a plant owned by your company or owned by another firm with whom you partner.

Appendix F
Transmission Entry Results

The electricity utility industry is our nation's most vital, exercising enormous influence on our standard of living and on the competitiveness of U.S. business and its capacity for jobs creation.[1]

-- Charles B. Curtis (1996)

F.1 SCENARIOS CONSIDERED FOR TRANSMISSION CONSTRUCTION BY A FIRM OTHER THAN THE UTILITY IN WHOSE SERVICE TERRITORY IT WOULD OCCUR

The fundamental question that is asked and answered in this section is: Under what conditions would it be favorable for a new entrant to build transmission capacity in the service territory of a utility that is not-affiliated with the new entrant? Specifically, we are looking for area(s) -- we will define an area as a state -- where it would be desirable to build the capacity. In order to answer the question, we will imagine several scenarios.

F.1.1 Who Might Build the New Transmission Capacity?

- IPPs
- Other utilities
- Industry outsiders
  - "Full service" energy companies
  - General Investors

F.1.2 Potential "Customers" of New Transmission Capacity

- The builder (generator/aggregator) would use it for its own sales
- The utility in whose service territory the assets would be built
- Users in adjoining regions that would use it to "bridge" large regional price differentials.

F.1.3 Current Regional Conditions

- Congestion (or not) on the system

F.2 STRUCTURAL ANALYSIS OF THE TRANSMISSION MARKET

NOTE: Criteria that were deemed totally irrelevant to this discussion are not accompanied by any "analysis."

CRITERIA AND ANALYSIS	VALUE	DATA NEEDED
I. THREAT OF ENTRY A. Barriers to Entry		
(1) *Economies of scale* - • There are significant economies of scale in the transmission segment of the industry that probably do not vary much by location.	III	

[1]Cited in: "Power Pundits Make Their Pitches," 42.

(2) *Product Differentiation* - • It should be noted that Porter defines product differentiation in terms of brand identification and customer loyalty. Using that definition, locating in an area where the local utility has developed negative "brand recognition" would make potential customers less concerned about entrusting their transmission needs to a "newcomer." Look for areas where there are customers who are significantly displeased with the local utility and are specifically looking for alternatives. • If one (the entrant) has an established reputation in the industry it would be easier to take advantage, at least somewhat, of Porter's product differentiation objectives.	I II	Surveys of utility customers - service ratings. Harder to measure - respect within industry.
(3) *Capital Requirements* - • Some areas have higher construction costs than others. Look for places where the costs are low because the highly capitalized transmission assets will not have a chance of competing with existing equipment in place if they are expensive to build.	II	Cost data for other projects in region.
(4) *Switching Costs* - The industry structure, regulated by the states, could be the source of significant switching costs or at least barriers to switching. For example, how stranded investment is handled could be very crucial. Look for places where fixed switching charges are not assessed up front. If switching charges are implemented, perhaps look for a place where they are charged every time a change in transmission providers is made, once a customer switches they will have a charge to pay if they leave you.	I	Rules promulgated by PUCs.
(5) *Access to Distribution Channels* - In all states, currently, this is a fundamental barrier to entry. One could only conceive of building a competitive transmission line where the PUC is considering, or already has, changed the rules regarding direct sales to consumers.	I	Rules or deliberations of PUCs
(6) *Cost Advantages Independent of Scale* - (a) Proprietary Product Technology - With transmission lines being so long-lived, this should not be an advantage of incumbents. (b) Favorable Access to Raw Materials - (c) Favorable locations - States differ significantly on the process for siting lines. Look for "easier" states. (d) government subsidies - (e) Learning or Experience Curve - Unless the entrant is a company with experience in operating transmission systems, look for states where ISOs will be running the system.	III III I III II	 Zoning rules Rules of Public Utility Commissions and other state agencies. State plans for deregulation
(7) *Government Policy* - Clearly, this may a fundamental barrier to entry. Look for locations where rules do not foreclose upon transmission construction or that are progressive in deregulation.	I	PUC policies or deliberations

B. Expected Retaliation With transmission rates likely to continue to be regulated, this should not be an issue in the foreseeable future.	III	
C. Entry Deterring Price Once again, with regulated rates, the established utility has limited ability to charge an entry deterring price. Furthermore, if utilities are functionally or corporately unbundled, they will not be able to "subsidize" transmission operations to keep competitors out.	III	
D. Properties of Entry Barriers		
(1) *They change for fundamental reasons* - we are seeing this in electric power, where the exclusive franchise concept is diminishing. It is this change in entry barriers (in generation) that makes this discussion even possible.	I	PUC Decisions/deliberations
(2) *They change for company strategic decision reasons* - In some cases, the utility may decide to abandon the transmission business altogether. This would bring in a new entrant - maybe two - creating an unstable market, but probably one with opportunity.	II	Stated intentions of executives Utility decisions
(3) *Resources allow overcoming of entry barriers* - If the entrant were the owner of a neighboring transmission system, this might be possible. Also, if an investor were willing to pour huge amounts of money into this for a strategic reason.	I	Location of other transmission assets.
E. Experience and Scale As Barriers - Limits		
(1) *Limit product differentiation* - This should not be a problem (for the incumbents) -- bigger utility systems may even make for more product differentiation.	III	
(2) *Technological change punishes* - only if new technologies are available.	III	
(3) Impacts Mind-set - These economies of scale perceptions are still justified.	III	
F. Nullification of Experience Barriers		
(1) *Process innovations leading to a new experience curve* - This would not vary spatially.	III	
(2) *Low cost through experience may cost product differentiation* - The ability to differentiate will probably increase with experience.	III	
(3) *Multiple firms using the experience approach may prove fatal* - Avoid areas where a multitude of firms will be entering with the hopes of garnering market share, rather than short terms profits, in order to "learn." Not a likely scenario though.	II	Intentions of potential competitors
(4) *Aggressive pursuit of cost declines through experience may draw attention away from developments* - This would only be possible if significant new technologies were to become available.	III	
B. INTENSITY OF RIVALRY AMONG EXISTING COMPETITORS 1. Intensity is caused by:		
(1) *Numerous or Equally Balanced Competitors* - Currently there is not competition anywhere. This would mean that whenever competition comes into being, it will be the established firm versus a variety of entrants (probably not more than one).	III	
(2) *Slow Industry Growth* - competition will be less intense in markets that are growing.	I	Data on transmission usage growth by region

(3) *High Fixed or Storage Costs* - this is a problem everywhere.	III	
(4) *Lack of Differentiation or Switching Costs* - A state may require that all transmission assets be run by an independent system operator, which would reduce differentiation.	II	PUC regulations regarding ISOs.
(5) *Capacity augmented in Large Increments* - Larger markets will be able to absorb new transmission capacity better than smaller control areas.	II	Energy supply within a control area or region.
(6) *Diverse Competitors* - There would not likely be more than one or two new entrants in any location.	III	
(7) *High Strategic Stakes* - Look for areas where the utility does not view transmission as vital to the essence of being a utility.	II	Attitudes of management of utility
(8) *High Exit Barriers* - This will presumably be true in all places, because of the specificity and high fixed cost of transmission equipment. Are there areas, though, where more of the transmission assets have been paid off.	II	Degree to which existing capacity must still be paid for within a region.
B. Shifting Rivalry - since a retail market has yet to exist, let us not examine this characteristic now.	III	
C. Exit Barriers and Entry Barriers - the objective is to look for areas where entry barriers are high (yet can be cleared by the particular investor) and exit barriers are low. Look for areas where regulations make entry more difficult -- siting.	II	Regulations of an area
III. PRESSURE FROM SUBSTITUTE PRODUCTS		
• At this time there is no substitute for transmission except for on-site generation. Areas where the major (potential) customers have already turned to this option would be more desirable, in that there would not be the potential for loss of power being transmitted.	II	Percent of power consumed in a region that is self-generated.
IV. BARGAINING POWER OF BUYERS A. Buyers are powerful if...		
(1) *Concentrated or purchases large volumes relative to seller sales* - The larger the number of generators, small distribution companies, and aggregators (in a restructured industry) the better.	I	Number of generators and aggregators/distribution companies in a region.
(2) *The products it purchases from the industry represent a significant fraction of the buyer's costs or purchases* - look for areas where the industry tends to be electricity intensive, which mean that their price elasticity is higher. Whether such facilities would be willing to trade lower price for less reliability (which is how a new entrant would be painted by the incumbent utility) is difficult to know.	II	Demographics of local industry
(3) *The products or purchases from the industry are standard or undifferentiated* - transmission service is spatially uniform in its differentiation.	III	
(4) *It faces few switching costs* - This would be determined by the types of contracts that one signs and how one agrees to provide service. If you have customers sign long-term contracts and disconnect themselves from other transmission lines there would be higher switching costs.	III	
(5) *It earns low profits* - Look for areas where the economy is robust. For example, at the present time avoid areas where defense is a large % of industry. The difficulty in this, though, is that one is making a 30+ year investment. "Massachusetts Miracles" come and go often within that period.	II	Profiles of incumbent businesses and their profitability.

(6) *Buyers pose a credible threat of backward integration* - Avoid areas where there are many price-sensitive customers that are large enough buyers to consider self-generation.	II	Size of price sensitive customers
(7) *The industry's product is unimportant to the quality of the buyer's products or services* - Look for areas where electric quality is important. The downside of this is that the incumbent utility will probably take the position of, "why trust your service to a new company when we've been around for 100 years."	III	
(8) *The buyer has full information* - Look for areas where the set-up is a longer term contract, with more proprietary economic dispatch data. Avoid electronic bulletin boards where buyers can purchase energy easily. This would not be possible if the FERC Mega-NOPR comes to fruition.	II	Structure of deregulation
B. Altering Buyer Power		
Buyer selection - this does not vary spatially.	III	
V. BARGAINING POWER OF SUPPLIERS Suppliers Can Exert Bargaining Power if...		
(1) *It is dominated by a few companies more concentrated than the industry it sells to* - Except for the companies that build the transmission equipment (which would be national in scope) there are no real suppliers to the industry. It is more appropriate to think of transmission as a conduit between two transmission customers.	III	
(2) *It is not obliged to contend with other substitute products for sale to the industry* - This is not a regional issue.	III	
(3) *The industry is not an important customer of the supplier group* - this is not really an issue, and to the degree that it is, it is not a region-based one.	III	
(4) *The supplier's product is an important input to the buyer's business* - This is spatially invariant.	III	
(5) *The supplier group's products are differentiated or it has built up switching costs* - this is not a regional issue.	III	
(6) *The supplier group poses a credible threat of forward integration* - This is not reasonable to consider.	III	
VI. GOVERNMENT AS A FORCE IN INDUSTRY COMPETITION		
• As has been seen throughout, the local government is one of the most important factors in determining a transmission line location. This is true because the industry we are attempting to differentiate, is fundamentally similar - it is only the buyers, sellers, and the regulatory environment which makes a difference from location to location.	I	State policies on transmission siting and progressiveness toward deregulation.

F.3 WHAT CHARACTERISTICS OF A LOCATION WOULD MAKE IT FAVORABLE FOR BUILDING NEW TRANSMISSION ASSETS?

IDENTIFY TARGET INDUSTRIES (or in this case, locations)		
CRITERIA AND ANALYSIS	**VALUE**	**DATA NEEDED**
1. Industry is in Disequilibrium -		
(a) *New Industries* - This whole discussion is completely moot unless the local regulatory commission is willing to allow other companies into the transmission business.	I	Intentions/Decisions of the PUC

(b) *Rising Entry Barriers* - Below is the criteria that Porter uses to judge the wisdom of early entry. They would all appear to be more characteristic of the industry in general, rather than concepts that could vary (or at least predictably so) as a function of location. Early Entry is desirable when: • Image and reputation of the firm are important to the buyer - • Early entry can initiate the learning process - • Customer loyalty will be great - • Absolute cost advantages can be gained by early commitment to resources - Early Entry is Risky when: • Early Competition and Market segmentation are on a basis that will be different later in the development of the industry - • Costs of opening up a market are great (customer information, regulations) - Yes, everywhere. • There will be costly competition with small firms while larger formidable ones will come in later with the economies of scale - • Technological change will make early assets obsolete - perhaps eventually, but there are many current assets that will become obsolete first.	III	
(c) *Poor Information* - If one knows a lot about a specific area, it might have an advantage in appraising the potential market and knowing how to go about competing in accord with local customs.	II	One's knowledge of an area
2. Slow or Ineffectual Retaliation		
(a) *Incumbents cost of effective retaliation outweighs the benefits* - Look for areas where a utility has newer (relatively unpaid for) transmission lines and therefore, simply can not afford to retaliate.	II	Age of existing transmission assets
(b) *There is a paternal dominant firm or tight group of long-standing leaders* - This is rather characteristic of the general utility industry.	III	
(c) *The entrant can exploit conventional wisdom* - Building a competitive transmission line would be contrary to the conventional wisdom everywhere.	III	
(d) *Incumbent's Costs of responding are great given the need to protect their existing businesses* - if the utility has a good reputation, its attempts to "squash" the new competition may be taken badly by the public - thus losing an advantage.	II	Current feelings toward utility
(3) Firm has lower entry costs than other firms - If one already operates in a region, most especially if it is a transmission utility in the region, it might face lower barriers to entry. Also, being a transmission utility in general might allow for lower costs. At the same time, though, not being in the utility industry might allow for a more lean operation.	II	
(4) The firm has a distinctive ability to influence the industry structure - Building a transmission line might give an IPP or an outside company a chance to change the paradigm of the industry.	I	Builder's strategy for the restructured industry.

(5) There will be positive effects on a firm's existing businesses - An existing IPP or utility may view the construction of a new transmission line as a way of facilitating demand for existing or expanded generation capabilities. Others, such as energy service companies might see opportunities as well.	I	What other businesses one owns.

F.4 CONSOLIDATION OF RESULTS

Having gone through the detailed sets of criteria, let us now consolidate the important results.

F.4.1 Structural Analysis Results

F.4.1.1 Threat of Entry

The threat of entry is lower with fewer barriers to entry. Hence look for areas where:
• The local utility is not in good standing with consumers.
• There are no policy-mandated switching costs.
• Transmission siting procedures are relatively easy.
• The PUC would allow a transmission line to be built by an entity other than the franchised utility.
• One has a presence in it already (IPP or other industry) or nearby (a neighboring transmission system).
• Willingness of the PUC to allow retail sales

F.4.1.2 Intensity of Rivalry Among Suppliers

Look for areas where:
• There are many distribution companies/aggregators.
• Demand is growing relatively quickly (either in the region or that passes through the region's transmission lines.)

F.4.1.3 Pressure From Substitute Products

There are no significant findings here.

F.4.1.4 Bargaining Power of Buyers

Look for areas where:
• There are many distribution companies/aggregators.

F.4.1.5 Bargaining Power of Suppliers

There are no significant findings here.

F.4.1.6 Government As a Force In Industry

• Look for areas where the state regulators are progressive with regard to deregulation.

F.4.2 Location Characteristics Results

Look for areas where:
• Regulatory commissions are progressive with regard to utility regulation.
• Existing businesses could be enhanced by the construction of a transmission line. Likely scenarios include a power aggregator or generator that would benefit from increased access to markets or a neighboring transmission company that would be looking to expand its system.
• One could create new market structures through the construction of a line. This would be especially true for an IPP or an aspiring comprehensive energy services company.
opportunities.

F.5 BALANCE OF FOUR IMPORTANT POINTS

When entering, one must balance:

(1) the investment costs to be in the new business, such as investment in manufacturing facilities and inventory

• Look for areas where the cost of construction is low.
• Look for areas where the siting process is less intensive and where compensation for externalities (such as environmental remediation) is low.

(2) The additional investment required to overcome structural entry barriers, such as brand identification and proprietary technology
Clearly an new entrant is in a difficult position, since there is already an established firm in place which has a natural monopoly.
• Look for areas where large customers are highly dissatisfied with their local utility and avoid areas where the utility is highly respected.

(3) Expected reaction of incumbent firms (in the form of retaliation)
• Look for areas where the utility is constrained from retaliation by regulation (probably everywhere).

(4) Expected cash flows from being in the business.
Transmission lines that carry power between regions between which there is a high price gradient would be expected to have the potential for high power and cash flows.

Frequently unanticipated caveats include:
(1) *Subtle barriers to entry (brand name recognition, access to distribution, etc.)*
• Avoid areas where the local utility might retains a strangle-hold on generation or distribution (i.e. there are few IPPs, aggregators, or public distribution systems).
• Avoid areas where the utility is well-liked

(2) *Effect of entrant's new capacity needs to be considered.*
• Areas where one's new transmission capacity will barely be noticed in the larger scheme of things will help to ensure that no radical price changes occur to do entry, and its impact on the supply-demand equilibrium. This might be wishful thinking, however, due to system economies of scale, the reserve margins that are standard in the industry, and the large blocks that transmission capacity is built in.

(3) *Reactions of existing firms*
• Look for an area in which the utility is not in a financial position to have a significant capacity expansion.

F.6 GENERIC STRATEGIES FOR ENTRY

(1) Reduce Product Costs		
(a) New Process Technology - When new technologies become available, opportunities will not vary spatially.	III	
(b) *Larger plant* Look for areas where high voltage lines have not been needed in the past but now are needed. (This might also be a sign of growth).	II	Knowledge of the grid and the voltages of lines.
(c) *More modern facilities* - Look for areas where the utility has older, less efficient lines in need of replacement. (This may not be likely, however due to the durability of transmission equipment).	III	Age and efficiency of transmission assets.
(d) *Shared activities with existing businesses that yield a cost advantage* - Are there cogenerators or other IPPs that are looking for more transmission access?	II	Needs of other companies.
(2) Buy In with Low Price - This is very difficult due to the high capital costs of transmission assets.	III	
(3) Offer a Superior Product, Broadly Defined - It would be nearly impossible, barring technological breakthroughs, to offer a superior product, broadly defined when one enters the transmission business.	III	

(4) <u>Discover a New Niche</u> - Look for areas where there are significant classes of customers with similar needs that could be met by a specific transmission line.	I	Profile of potential customers
(5) <u>Introduce a Marketing Innovation</u> - Are there new ways in which the entrant could bundle transmission based upon the capabilities of the firm and the needs of potential customers in a region?	III	Location of assets Competencies of entrant Needs of consumers
(6) <u>Use Piggybacked Distribution</u> - If the potential entrant runs other businesses, then locate in an area where it has multiple current customers/suppliers with whom it has a good relationship.	II	location of customers/suppliers

F.7 GENERAL CONCLUSIONS

Based upon this process, criteria for determining a preferred area for building a transmission line are as follows:

- Before anything else, the local authorities must be open to progressive regulatory policies.
- The state has a relatively easy transmitting siting process.
- The cost of line construction, including compensation for environmental externalities, is low.
- The local utility has many dissatisfied customers.
- New transmission capacity would facilitate a company's existing business, whether it be an IPP, neighboring utility, or an energy services company that faces constraints or unfavorable terms.
- Demand is growing relatively quickly - whether it be in the immediate region or as a result of being located between regions with high electricity price differentials.
- There are many distribution companies/aggregators and/or non-concentrated ownership of generators in the region.
- An IPP or other energy supplier views an opportunity to create a new market structure in the region through the construction of a transmission line.
- Look for particular places where an additional line might be needed to meet the needs of a niche users.

Appendix G
Porter's Acquisition Framework

The Industry will have winners and losers, champions and fallen giants who lacked the vision to compete.[1]

-- Entergy Annual Report (1993)

PORTER'S ACQUISITION STRATEGY

CHAPTER 3 - A FRAMEWORK FOR COMPETITIVE ANALYSIS

Forecasting acquisitions can be done in the same logic as forecasting potential entrants.
(which are)
- Firms not in the industry but who could overcome entry barriers particularly easily.
- Firms for whom there is obvious synergy from being in the industry
- Firms for whom competing in the industry is an obvious extension of corporate strategy
- Customers or suppliers who may integrate backward or forward

CHAPTER 9 - FRAGMENTED INDUSTRIES

One approach to consolidation

In some industries there may ultimately be some advantages to holding a significant share, but it is hard to build share incrementally because of the causes of fragmentation. If local contracts are important, this would be the case... If an acquisition allows one to reach a threshold share, it can allow for significant advantages of scale.

CHAPTER 16 - ENTRY THROUGH ACQUISITION

"Entry through acquisition is subject to a completely different analytical framework than entry through internal development because acquisition does not add a new firm to the industry in the direct sense." (p. 350)

The critical point is the recognition that the price of an acquisition is set in the market for companies. An efficient market for companies works to eliminate any above-average profits. (and Porter indicates that this is the case now in the U.S.)

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[1]Entergy, 1993, B.

Generally, the seller has the option to continue or to sell. This creates a *floor price*.

The analysis suggests that it is quite hard to win at the acquisition game.

Acquisitions will most likely be profitable if:
1. The floor price created by the seller's alternative of keeping the business is low
2. The market for companies is imperfect and does not eliminate above-average returns through the bidding process.
3. The buyer has a unique ability to operate the acquired business

"It is crucial to note that the bidding process can eliminate the profitability of an acquisition even if the floor price is low. Thus favorable conditions in at least two of the areas are necessary for success."

Also, it is important to understand the motives and situations of other potential bidders.

Appendix H
Generation Acquisition Results

> *As our experience with long distance, gas and local telephone service showed, once the notion of a 'natural monopoly' is challenged it is only a matter of when -- not if -- competition will come... The fact is that no 'unnatural' monopoly has ever successfully fought off competition once it has started.*[1]
>
> -- *Dan Schaefer (1996)*

H.1 CONSIDERATIONS REGARDING UTILITY GENERATION SALES

H.1.1 Why Would A Utility Want To Sell Its Generation Assets?

- It must by law;
- To escape an unfavorable regulatory situation;
- It does not feel that it could effectively compete in a competitive generation business;
- It wants to focus on what it thinks it can do best (T&D); and
- It views generation as becoming a commodity business, with sub-standard returns to its shareholders.

H.1.2 Types Of Utility Buyers

- Utility that operates contiguously to the acquired;
- Utility whose operation is not contiguous, but is within the same jurisdiction (as the acquired);
- Utility in the same NERC region (as the acquired); and
- Utility that is not in close proximity to the acquired.

H.1.3 Types Of IPP Buyers

- IPP within service territory of utility;
- IPP within same jurisdiction as utility;
- IPP within same NERC region as utility; and
- IPP entering into new area.

H.1.4 Types Of Buyers Who Are Not "Currently in The Business" (Non-utilities, Non-IPPs)

- Closely-related electric companies (such as GE, Bechtel);
- Closely-related non-electric companies (gas companies); and
- Unrelated companies.
  - large electricity users

H.1.5 Assumptions About The Region

- Constricted/surplus capacity within NERC region;
- High/low cost electricity within NERC region;
- State regulatory environment favorable/unfavorable to retail wheeling; and
- Many/some/few significant players that are competitively-oriented.

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[1]Cited in: "Schaefer Wants EEI 'Honesty' on Competition Legislation."

H.2 Question: From The Viewpoint Of A Current Utility, Under What Situations Would It Be Desirable To Purchase The Generation Assets Of Another Utility?

H.2.1 Analysis

ENTRY THROUGH ACQUISITION		
CRITERIA AND ANALYSIS	**VALUE**	**DATA NEEDED**
FAVORABLE CONDITIONS IN 2 OF THE FOLLOWING THREE (I. - III.) ARE NECESSARY		
I. THE HEIGHT OF THE FLOOR PRICE (will be low if...)		
1. The seller feels a compulsion to sell		
(a) *The seller has estate problems* - This does not seem like a problem for a utility.	III	
(b) *The seller needs capital quickly* - This may not be capital for expansion (although it conceivably could). It may be money needed to keep the utility afloat. Even now there are a few utilities "near the brink." As competition continues there might be a desire to sell off generation assets in order to stay liquid.	I	Financial situation of company
(c) *The seller has lost key management or sees no successors for existing management* - In a public utility this should not be a problem. In an organization that large they would likely look outside when management leaves if there are not capable successors on the inside. In fact, as the business is rapidly changing, a Board might want be inclined to look outside anyway. What is not here, yet is clearly applicable is that a utility might be forced to sell by law (as may yet happen in CA)	III I	Departures of key managers and the succession process New state regulations
2. The seller is not optimistic about its ability to continue to run the business.		
(a) *The seller perceives capital constraints to growth*- Look at the financial situation of the utility.	II	Company finances
(b) *The seller recognizes its managerial weaknesses*- Look for utilities where the upper management is all from a utility background and/or does not seem comfortable with the new competitive environment.	I	Profiles of management There public comments - perhaps even material in the company quarterly and annual reports.
II. IMPERFECTIONS IN THE MARKET FOR COMPANIES		
1. The buyer has superior information - A utility from the same jurisdiction or region MIGHT have a better ability to know the potential for growth than those from further away. However, such benefits will likely be marginal. Also, there could be market share problems with such a bid as well. (Although from the point of view of PUHCA it might be desirable.)	II	Location *vis-à-vis* other bidders

2. The number of bidders is low - Look for assets that attract little attention. (However, there might be reasons for this lack of attention.)	I	General feel of interest
3. The condition of the economy is bad - Utility assets that are freed during an economic downturn would likely be more desirable. Especially since the freeing of assets may be due to regulatory reasons, rather than economic ones, they might be cut loose at "opportune" times for a potential buyer (provided that the buyer is in a sufficiently sound position to bid.)	II	Economic statistics
4. The selling company is sick - Look for companies on the verge of bankruptcy (or in bankruptcy.)	I	Information about company health
5. The seller has objectives besides maximizing the price received for the businesses - It is POSSIBLE that a utility acquirer might have a slight advantage over IPPs or outsiders in that management might feel a desire to keep some vestige of utility ownership or a belief that a utility might cut fewer employees. However, given that IOUs are large public corporations sentiments probably are not very significant.	II	Intangible sentiments of current management
III. UNIQUE ABILITY TO OPERATE THE SELLER		
1. The buyer has a distinctive ability to improve the operation of the seller - A well-run utility would be able to have an advantage over other potential buyers given its successful experience at operating a large amount of capacity.	I	Operational capability of "buyer" utility
2. The firm buys into an industry that meets the criteria for internal entry from last discussion we found these to be: • *regulatory body open to competition -* • *region where a business currently operates -* • *where the other utilities are not competitively-oriented -* • *where an entrant might be able to take advantage of a unique market structure -*	 I I I I	
3. The acquisition will uniquely help a buyer's position in its existing businesses - A close-by utility's assets could be particularly appealing, especially if they would increase the ability to create a differentiated product. Also, if the "seller" utility had some generation competencies that were lacking in the "buyer's" repertoire.	I I	Location of utility assets vis-à-vis acquirer's assets Competencies of the seller's generation assets vis-à-vis those in the buyers
IV. CAUSES OF "IRRATIONAL BIDDING"		
1. The bidder sees a unique way to improve the acquisition target - are there "logical" bidders because of a unique ability to improve the utility assets?	I	Examine qualities of other potential bidders.

2. <u>The acquisition will help the bidder's existing business</u> - Is there a company, such as a natural gas company, that is seeking to become a "full service energy service" company.	I	Intentions of other companies in region
3. <u>The bidder has goals or motives other than the maximization of profit</u> - • growth potential - is there an IPP or utility in the region that is known to desire growth • one-shot financial gain - is there is major user of electricity in a region that might see this as a way of lowering rates and creating an income stream? (This is probably most likely in the event that generation assets are sold piece-meal rather than in large blocks.) • management idiosyncrasies - is there someone around who desperately wants to run old generators - this is very unlikely because they could enter, probably for less hassle, via a new plant.	 I I III	 Intentions of other IPPs or utilities. Perhaps, also, look for companies such as US Gen. who might be seeking entry into an area. Intentions of major industrial users

H.2.2 Results

From this, we see that potentially beneficial asset-specific situations would include:
- When a utility is in poor financial shape.
- When divestment is forced by law (this does not come specifically from Porter's initial criteria.)
- When a generating company has managerial weaknesses with regard to competition.
- When there are few potential bidders.

AND
- If the "buyer" utility is especially competent at running efficient generating plants.
- If the purchase of the generating assets would increase the ability of the "buyer" utility to offer a differentiated product.
- If the "seller" utility has some important competencies that the "buyer" utility lacks.

Desirable characteristics of the region where the utility assets are located include:
- where an entrant might be able to take advantage of a unique market structure
- where the other utilities are not competitively-oriented
- region where the company currently operates
- regulatory body open to competition

Situations to avoid (or to be wary of excessive bids):
- A utility or IPP in the region is a "logical acquirer" because of their superior generation business performance or because of ties that already exists that would give them an advantage in running the plant.
- Another company sees these assets as the ability to become a full-service energy services company or to lower its own electrical bill while creating an additional revenue source.
- Another utility or IPP sees the generation assets in question as being particularly attractive for future growth.

H.3 QUESTION: FROM THE VIEWPOINT OF A CURRENT IPP, UNDER WHAT SITUATIONS WOULD IT BE DESIRABLE TO PURCHASE THE GENERATION ASSETS OF A UTILITY?

H.3.1 Analysis

ENTRY THROUGH ACQUISITION CRITERIA AND ANALYSIS	VALUE	DATA NEEDED
FAVORABLE CONDITIONS IN 2 OF THE FOLLOWING THREE (I. - III.) ARE NECESSARY		
I. THE HEIGHT OF THE FLOOR PRICE (will be low if...)		
1. The seller feels a compulsion to sell		
(a) *The seller has estate problems* - This does not seem like a problem for a utility.	III	
(b) *The seller needs capital quickly* - This may not be capital for expansion (although it conceivably could). It may be money needed to keep the utility afloat. Even now there are a few utilities "near the brink." As competition continues there might be a desire to sell off generation assets in order to stay liquid.	I	Financial situation of company
(c) *The seller has lost key management or sees no successors for existing management* - In a public utility this should not be a problem. In an organization that large they would likely look outside when management leaves if there are not capable successors on the inside. In fact, as the business is rapidly changing, a Board might want be inclined to look outside anyway. What is not here, yet is clearly applicable is that a utility might be forced to sell by law (as may yet happen in CA)	III I	Departures of key managers and the succession process New state regulations
2. The seller is not optimistic about its ability to continue to run the business.		
(a) *The seller perceives capital constraints to growth*- Look at the financial situation of the utility.	II	Company finances
(b) *The seller recognizes its managerial weaknesses*- Look for utilities where the upper management is all from a utility background and/or does not seem comfortable with the new competitive environment.	I	Profiles of management There public comments - perhaps even material in the company quarterly and annual reports.
II. IMPERFECTIONS IN THE MARKET FOR COMPANIES		
1. The buyer has superior information - An IPP from the same jurisdiction or region MIGHT have a better ability to know the potential for growth than those from further away. However, such benefits will likely be marginal. Further, there could be some market-power concerns with an IPP in a region purchasing large amounts of utility capacity.	II	Location *vis-à-vis* other bidders
2. The number of bidders is low - Look for assets that attract little attention. (However, there might be reasons for this lack of attention.)	I	General feel of interest

3. The condition of the economy is bad - Utility assets that are freed during an economic downturn would likely be more desirable. Especially since the freeing of assets may be due to regulatory reasons, rather than economic ones, they might be cut loose at "opportune" times for a potential buyer (provided that the buyer is in a sufficiently sound position to bid.)	II	Economic statistics
4. The selling company is sick - Look for companies on the verge of bankruptcy (or in bankruptcy.)	I	Information about company health
5. The seller has objectives besides maximizing the price received for the businesses If an IPP has had a historically-good relationship with the utility via power-purchasing contracts with a utility it might have a slight advantage. However, given that IOUs are large public corporations sentiments probably are not very significant.	II	Historical relationship between companies Intangible sentiments of current management
III. UNIQUE ABILITY TO OPERATE THE SELLER		
1. The buyer has a distinctive ability to improve the operation of the seller - An IPP with high competence in efficient operations would have an advantage over less operationally competent bidders.	I	IPP's capability to run efficient generation plants.
2. The firm buys into an industry that meets the criteria for internal entry from last discussion we found these to be: • *regulatory body open to competition -* • *region where a business currently operates -* • *where the other utilities are not competitively-oriented -* • *where an entrant might be able to take advantage of a unique market structure -*	 I I I I	
3. The acquisition will uniquely help a buyer's position in its existing businesses - If a local IPP is looking to expand market share, product differentiation, or if a remote IPP is attempting to enter a new area (and see such a strategy as vital for future success), acquisition would be one route.	I	IPP market strategy
IV. CAUSES OF "IRRATIONAL BIDDING"		
1. The bidder sees a unique way to improve the acquisition target - are there "logical" bidders because of a unique ability to improve the utility assets?	I	Examine qualities of other potential bidders.
2. The acquisition will help the bidder's existing business - Is there a company, such as a natural gas company, that is seeking to become a "full service energy service" company.	I	Intentions of other companies in region

3. The bidder has goals or motives other than the maximization of profit - • growth potential - is there an IPP or utility in the region that is known to desire growth	I	Intentions of other IPPs or utilities. Perhaps, also, look for companies such as US Gen. who might be seeking entry into an area.
• one-shot financial gain - is there is major user of electricity in a region that might see this as a way of lowering rates and creating an income stream? (This is probably most likely in the event that generation assets are sold piece-meal rather than in large blocks.)	I	Intentions of major industrial users
• management idiosyncrasies - is there someone around who desperately wants to run old generators - this is very unlikely because they could enter, probably for less hassle, via a new plant.	III	

H.3.2 Results

From this, we see that potentially beneficial asset-specific situations would include:
• When a utility is in poor financial shape.
• When divestment is forced by law (this does not come specifically from Porter's initial criteria.)
• When a generating company has managerial weaknesses with regard to competition.
• When there are few potential bidders.

AND

• If the potential buyer IPP is a highly competent generator
• If the purchase would assist growth plans that are seen as vital for growth.
• If the purchase would allow the IPP to create a differentiated product.

Desirable characteristics of the region where the utility assets are located include:
• where an entrant might be able to take advantage of a unique market structure
• where the other utilities are not competitively-oriented
• region where the IPP currently operates
• regulatory body open to competition

Situations to avoid (or to be wary of excessive bids):
• A utility or IPP in the region is a "logical acquirer" because of their superior generation business performance or because of ties that already exists that would give them an advantage in running the plant.
• Another company sees these assets as the ability to become a full-service energy services company or to lower its own electrical bill while creating an additional revenue source.
• Another utility or IPP sees the generation assets in question as being particularly attractive for future growth.

H.4 QUESTION: FROM THE VIEWPOINT OF AN "ELECTRICITY OUTSIDER," UNDER WHAT SITUATIONS WOULD IT BE DESIRABLE TO PURCHASE THE GENERATION ASSETS OF A UTILITY?"

H.4.1 Analysis

ENTRY THROUGH ACQUISITION		
CRITERIA AND ANALYSIS	**VALUE**	**DATA NEEDED**
FAVORABLE CONDITIONS IN 2 OF THE FOLLOWING THREE (I. - III.) ARE NECESSARY		
I. THE HEIGHT OF THE FLOOR PRICE (will be low if...)		
1. The seller feels a compulsion to sell		
(a) *The seller has estate problems* - This does not seem like a problem for a utility.	III	
(b) *The seller needs capital quickly* - This may not be capital for expansion (although it conceivably could). It may be money needed to keep the utility afloat. Even now there are a few utilities "near the brink." As competition continues there might be a desire to sell off generation assets in order to stay liquid.	I	Financial situation of company
(c) *The seller has lost key management or sees no successors for existing management* - In a public utility this should not be a problem. In an organization that large they would likely look outside when management leaves if there are not capable successors on the inside. In fact, as the business is rapidly changing, a Board might want be inclined to look outside anyway. What is not here, yet is clearly applicable is that a utility might be forced to sell by law (as may yet happen in CA)	III I	Departures of key managers and the succession process New state regulations
2. The seller is not optimistic about its ability to continue to run the business.		
(a) *The seller perceives capital constraints to growth*- Look at the financial situation of the utility.	II	Company finances
(b) *The seller recognizes its managerial weaknesses*- Look for utilities where the upper management is all from a utility background and/or does not seem comfortable with the new competitive environment.	I	Profiles of management There public comments - perhaps even material in the company quarterly and annual reports.
II. IMPERFECTIONS IN THE MARKET FOR COMPANIES		
1. The buyer has superior information - A company from the same region MIGHT have a better ability to know the potential for growth than those from further away. However, such benefits will likely be marginal.	II	Location *vis-a-vis* other bidders
2. The number of bidders is low - Look for assets that attract little attention. (However, there might be reasons for this lack of attention.)	I	General feel of interest

3. The condition of the economy is bad - Utility assets that are freed during an economic downturn would likely be more desirable. Especially since the freeing of assets may be due to regulatory reasons, rather than economic ones, they might be cut loose at "opportune" times for a potential buyer (provided that the buyer is in a sufficiently sound position to bid.)	II	Economic statistics
4. The selling company is sick - Look for companies on the verge of bankruptcy (or in bankruptcy.)	I	Information about company health
5. The seller has objectives besides maximizing the price received for the businesses - Perhaps, if the outside company has had a good business relationship with the utility there might be a bit of an advantage. However, given that IOUs are large public corporations sentiments probably are not very significant.	II	Historical relationship between companies Intangible sentiments of current management
III. UNIQUE ABILITY TO OPERATE THE SELLER		
1. The buyer has a distinctive ability to improve the operation of the seller - It is likely that there are IPPs or other utilities who are better positioned to operate a large existing set of plants.	III	
2. The firm buys into an industry that meets the criteria for internal entry from last discussion we found these to be: • *regulatory body open to competition -* • *region where a business currently operates -* • *where the other utilities are not competitively-oriented -* • *where an entrant might be able to take advantage of a unique market structure -*	 I I I I	
3. The acquisition will uniquely help a buyer's position in its existing businesses - Given that these assets already exist, there would be less incentive for a company such as GE, Bechtel, or a natural gas supply company to purchase the assets than in building new ones. However, a company that is striving to be a full-service energy services provider might see utility generation assets as a segue into a market it wishes to capture.	I	Goals of the particular acquirer
IV. CAUSES OF "IRRATIONAL BIDDING"		
1. The bidder sees a unique way to improve the acquisition target - are there "logical" bidders because of a unique ability to improve the utility assets?	I	Examine qualities of other potential bidders.
2. The acquisition will help the bidder's existing business - Is there a company, such as a natural gas company, that is seeking to become a "full service energy service" company.	I	Intentions of other companies in region

3. The bidder has goals or motives other than the maximization of profit - • growth potential - is there an IPP or utility in the region that is known to desire growth	I	Intentions of other IPPs or utilities. Perhaps, also, look for companies such as US Gen. who might be seeking entry into an area.
• one-shot financial gain - is there is major user of electricity in a region that might see this as a way of lowering rates and creating an income stream? (This is probably most likely in the event that generation assets are sold piece-meal rather than in large blocks.)	I	Intentions of major industrial users
• management idiosyncrasies - is there someone around who desperately wants to run old generators - this is very unlikely because they could enter, probably for less hassle, via a new plant.	III	

H.4.2 Results

From this, we see that potentially beneficial asset-specific situations would include:
• When a utility is in poor financial shape.
• When divestment is forced by law (this does not come specifically from Porter's initial criteria.)
• When a generating company has managerial weaknesses with regard to competition.
• When there are few potential bidders.

AND
• If the utility assets would help achieve a goal, such as the ability to be a full-service energy provider and/or lower electricity rates while providing some extra revenues.

Desirable characteristics of the region where the utility assets are located include:
• where an entrant might be able to take advantage of a unique market structure
• where the other utilities are not competitively-oriented
• region where the company currently operates
• regulatory body open to competition

Situations to avoid (or to be wary of excessive bids):
• A utility or IPP in the region is a "logical acquirer" because of their superior generation business performance or because of ties that already exists that would give them an advantage in running the plant.
• Another company sees these assets as the ability to become a full-service energy services company or to lower its own electrical bill while creating an additional revenue source.
• Another utility or IPP sees the generation assets in question as being particularly attractive for future growth.

Appendix I
Transmission Acquisition Results

Despite the enormous importance of the electricity transmission system in the U.S. and its key role in creating more competitive power markets, surprisingly few people know much about the physical characteristics of the network and the costs to operate it.[1]

-- *Resource Data International (1995)*

I.1 CONSIDERATIONS REGARDING UTILITY TRANSMISSION SALES

In this appendix we use Porter's framework to determine when it would be attractive for a buyer to purchase the transmission assets of a utility (i.e. when a buyer would be able to purchase them for a sub-economic price.) First let us establish several scenarios for this to occur.

I.1.1 Why Would A Utility Sell Its Transmission Assets?

- It must by law;
- To escape an unfavorable regulatory situation; or
- Strategic purposes.

I.1.2 Who Might Purchase Transmission Assets?

- IPPs;
- Other Utilities: or
- New Transcos
  - Other energy companies
  - Owned by transmission equipment builders
  - A government established one

I.1.3 Assumptions About The Region

- Constricted/surplus capacity within the region.

I.2 UNDER WHAT CONDITIONS WOULD IT BE DESIRABLE FOR A NEW ENTRANT TO PURCHASE A UTILITY'S TRANSMISSION ASSETS?

I.2.1 Analysis

ENTRY THROUGH ACQUISITION		
CRITERIA AND ANALYSIS	**VALUE**	**DATA NEEDED**
FAVORABLE CONDITIONS IN 2 OF THE FOLLOWING THREE (I. - III.) ARE NECESSARY		
I. THE HEIGHT OF THE FLOOR PRICE (will be low if...)		
1. The seller feels a compulsion to sell		
(a) *The seller has estate problems* - This does not seem like a problem for a utility.	III	

[1] "Transmission Markets in the U.S.," 1995, 3.

(b) *The seller needs capital quickly* - This may not be capital for expansion (although it conceivably could). It may be money needed to keep the utility afloat. Even now there are a few utilities "near the brink." As competition continues there might be a desire to sell off transmission assets (which some believe to be worth more than their embedded cost) in order to stay liquid.	I	Financial situation of company
(c) *The seller has lost key management or sees no successors for existing management* - In a public utility this should not be a problem. An organization that large would likely look outside when management leaves if there are no capable successors on the inside. In fact, as the business is rapidly changing, a Board might want be inclined to look outside anyway. What is not included in Porter's framework, but is clearly applicable is that a utility might be forced by law to sell its transmission assets.	III I	Departures of key managers and the succession process New state regulations
2. <u>The seller is not optimistic about its ability to continue to run the business.</u>		
(a) *The seller perceives capital constraints to growth*- Look at the financial situation of the utility. Much of the capital of transmission lines is already invested and long-lived.	II	Company finances
(b) *The seller recognizes its managerial weaknesses*- Look for utilities where the upper management is all from a utility background and/or does not seem comfortable with the new competitive environment.	II	Profiles of management There public comments - perhaps even material in the company quarterly and annual reports.
II. IMPERFECTIONS IN THE MARKET FOR COMPANIES		
1. <u>The buyer has superior information</u> - A company in the same jurisdiction or region MIGHT have a better ability to know the potential for growth than those from further away. However, such benefits will likely be marginal.	II	Location *vis-à-vis* other bidders
2. <u>The number of bidders is low</u> - Look for assets that attract little attention. A government mandated Transco would obviously cause only a single bid.	I	General feel of interest
3. <u>The condition of the economy is bad</u> - Utility assets that are freed during an economic downturn would likely be more desirable. Especially since the freeing of assets may be due to regulatory reasons, rather than economic ones, they might be cut loose at "opportune" times for a potential buyer (provided that the buyer is in a sufficiently sound position to bid.)	II	Economic statistics
4. <u>The selling company is sick</u> - Look for companies on the verge of bankruptcy (or in bankruptcy).	I	Information about company health

5. The seller has objectives besides maximizing the price received for the businesses - Due to the regulated nature of the business and the focus that is now being placed on the industry, a utility that attempts to sell based upon intangible criteria would face serious scrutiny -- especially if the sale would have implications for the recovery of stranded investments.	III	
III. UNIQUE ABILITY TO OPERATE THE SELLER		
1. The buyer has a distinctive ability to improve the operation of the seller - The only benefit that a true outsider might bring would be a substantial influx of capital to replace aging facilities, etc.	II	Capital of investor.
In the case of a state-Transco, it would allow a greater coordination of the grid (combining the multiple utilities in a state).	I	State regulations
2. The firm buys into an industry that meets the criteria for internal entry in Appendix D we found these to be:		
• *regulatory body open to competition -*	I	• PUC decisions
• *region of rising transmission growth (due to transmission within or across region)*	I	• Statistics on transmission growth
• *Ownership of transmission capacity would facilitate a company's existing business* - for example, it could create natural gas pipelines over wires.	I	• Buyer's strategic plan and current situation
• *where a new transmission entrant might be able to create a new market structure* - This could be the event that opens transmission ownership to anyone. A government mandated Transco certainly would.	I	• Buyer's strategic plan and current situation
3. The acquisition will uniquely help a buyer's position in its existing businesses - Given that these assets already exist, there would be less incentive for a transmission construction company than to build new ones. However, a company that is striving to be a full-service energy services provider might see utility generation assets as a segue into a market it wishes to capture -- transmission assets could be viewed as natural gas pipelines on wires.	I	Intent of the new entrant.
IV. CAUSES OF "IRRATIONAL BIDDING"		
1. The bidder sees a unique way to improve the acquisition target - are there "logical" bidders because of a unique ability to improve the utility assets - particularly is there a utility in the region with an excellent transmission service history or that could take advantage of economies of scale?	I	Examine qualities of other potential bidders.
2. The acquisition will help the bidder's existing business - Is there a company, such as a natural gas company, that is seeking to become a "full service energy service" company?	I	Intentions of other companies in region

3. <u>The bidder has goals or motives other than the maximization of profit</u> - • growth potential - is there a market player in the region that sees transmission ownership as a key to growth - perhaps by having a steady revenue stream?	I	Intentions of other players.
• one-shot financial gain - is there is major user of electricity in a region that might see this as a way of lowering rates and creating an income stream? (The size and nature of such an investment, however, would make this somewhat unlikely.)	II	Intentions of major industrial users
• management idiosyncrasies - is there someone around who desperately wants to run a transmission system?.	III	

I.2.2 <u>Results</u>

From this, we see that potentially beneficial asset-specific situations would include:
• When a utility is in poor financial shape.
• When divestment is forced by law (this does not come specifically from Porter's initial criteria.)
• When there are few potential bidders.

AND

• If the new entrant would use its ownership of transmission to become a full service energy provider.
• If the transmission purchase would enable new industry structures that would open the transmission industry to IPPs and other non-utilities.
• If transmission ownership would help facilitate sales from existing or future plants.

Desirable characteristics of the region where the utility assets are located include:
• where an entrant might be able to take advantage of a unique market structure
• regulatory body open to competition
• region of growth for transmission demand (whether it be in or through the region)

Situations to avoid (or to be wary of excessive bids):
• A player in the region sees transmission ownership as a key to its growth.
• A utility that is an excellent transmission utility who might want to expand its service territory or who could benefit from economies of scale through a merger of transmission systems.
• Another company sees these assets as the ability to become a full-service energy services company or to lower its own electrical bill while creating an additional revenue source.

I.3 UNDER WHAT CONDITIONS WOULD IT BE DESIRABLE FOR AN IPP TO PURCHASE A UTILITY'S TRANSMISSION ASSETS?

I.3.1 <u>Analysis</u>

ENTRY THROUGH ACQUISITION		
CRITERIA AND ANALYSIS	**VALUE**	**DATA NEEDED**
FAVORABLE CONDITIONS IN 2 OF THE FOLLOWING THREE (I. - III.) ARE NECESSARY		
I. THE HEIGHT OF THE FLOOR PRICE (will be low if...)		
1. <u>The seller feels a compulsion to sell</u>		

(a) *The seller has estate problems* - This does not seem like a problem for a utility.	III	
(b) *The seller needs capital quickly* - This may not be capital for expansion (although it conceivably could). It may be money needed to keep the utility afloat. Even now there are a few utilities "near the brink." As competition continues there might be a desire to sell off transmission assets (which some believe to be worth more than their embedded cost) in order to stay liquid.	I	Financial situation of company
(c) *The seller has lost key management or sees no successors for existing management* - In a public utility this should not be a problem. An organization that large would likely look outside when management leaves if there are no capable successors on the inside. In fact, as the business is rapidly changing, a Board might want be inclined to look outside anyway. What is not included in Porter's framework, but is clearly applicable is that a utility might be forced by law to sell its transmission assets.	III I	Departures of key managers and the succession process New state regulations
2. The seller is not optimistic about its ability to continue to run the business.		
(a) *The seller perceives capital constraints to growth*- Look at the financial situation of the utility. Much of the capital of transmission lines is already invested and long-lived.	II	Company finances
(b) *The seller recognizes its managerial weaknesses*- Look for utilities where the upper management is all from a utility background and/or does not seem comfortable with the new competitive environment.	II	Profiles of management There public comments - perhaps even material in the company quarterly and annual reports.
II. IMPERFECTIONS IN THE MARKET FOR COMPANIES		
1. The buyer has superior information - An IPP from the same jurisdiction or region MIGHT have a better ability to know the potential for growth than those from further away. However, such benefits will likely be marginal. It may be because it has plans to increase the use of the transmission system for its own purposes.	II	Location *vis-à-vis* other bidders
2. The number of bidders is low - Look for assets that attract little attention.	I	General feel of interest
3. The condition of the economy is bad - Utility assets that are freed during an economic downturn would likely be more desirable. Especially since the freeing of assets may be due to regulatory reasons, rather than economic ones, they might be cut loose at "opportune" times for a potential buyer (provided that the buyer is in a sufficiently sound position to bid.)	II	Economic statistics
4. The selling company is sick - Look for companies on the verge of bankruptcy (or in bankruptcy).	I	Information about company health

5. The seller has objectives besides maximizing the price received for the businesses - Due to the regulated nature of the business and the focus that is now being placed on the industry, a utility that attempts to sell based upon intangible criteria would face serious scrutiny -- especially if the sale would have implications for the recovery of stranded investments.	III	
III. UNIQUE ABILITY TO OPERATE THE SELLER		
1. The buyer has a distinctive ability to improve the operation of the seller - An IPP with high competence in efficient operations would have an advantage over less operationally competent bidders.	I	IPP's capability to run efficient generation plants.
2. The firm buys into an industry that meets the criteria for internal entry In Appendix D we found these to be: • *regulatory body open to competition -* • *region of rising transmission growth (due to transmission within or across region)* • *Ownership of transmission capacity would facilitate a company's existing business -* • *where a new transmission entrant might be able to create a new market structure -*	 I I I I	 • PUC decisions • Statistics on transmission growth • Buyer's strategic plan and current situation • Buyer's strategic plan and current situation
3. The acquisition will uniquely help a buyer's position in its existing businesses - An IPP might view the acquisition of transmission lines as a way of more effectively reaching customers.	I	IPP market strategy
IV. CAUSES OF "IRRATIONAL BIDDING"		
1. The bidder sees a unique way to improve the acquisition target - are there "logical" bidders because of a unique ability to improve the utility assets - particularly is there a utility in the region with an excellent transmission service history or that could take advantage of economies of scale?	I	Examine qualities of other potential bidders.
2. The acquisition will help the bidder's existing business - Is there a company, such as a natural gas company, that is seeking to become a "full service energy service" company?	I	Intentions of other companies in region
3. The bidder has goals or motives other than the maximization of profit - • growth potential - is there a market player in the region that sees transmission ownership as a key to growth - perhaps by having a steady revenue stream? • one-shot financial gain - is there is major user of electricity in a region that might see this as a way of lowering rates and creating an income stream? (The size and nature of such an investment, however, would make this somewhat unlikely.) • management idiosyncrasies - is there someone around who desperately wants to run a transmission system?	 I II III	 Intentions of other players. Intentions of major industrial users

I.3.2 Results

From this, we see that potentially beneficial asset-specific situations would include:
- When a utility is in poor financial shape.
- When divestment is forced by law (this does not come specifically from Porter's initial criteria.)
- When there are few potential bidders.

AND

- If the transmission purchase would enable new industry structures that would open the transmission industry to IPPs and other non-utilities.
- If transmission ownership would help facilitate sales from existing or future plants.

Desirable characteristics of the region where the utility assets are located include:
- where an entrant might be able to take advantage of a unique market structure
- region where the IPP currently operates
- regulatory body open to competition
- region of growth for transmission demand (whether it be in or through the region)

Situations to avoid (or to be wary of excessive bids):
- A player in the region sees transmission ownership as a key to its growth.
- A utility that is an excellent transmission utility who might want to expand its service territory or who could benefit from economies of scale through a merger of transmission systems.
- Another company sees these assets as the ability to become a full-service energy services company or to lower its own electrical bill while creating an additional revenue source.

I.4 UNDER WHAT CIRCUMSTANCES WOULD IT BE DESIRABLE FOR A UTILITY TO PURCHASE THE TRANSMISSION ASSETS OF ANOTHER (UTILITY)?

I.4.1 Analysis

ENTRY THROUGH ACQUISITION		
CRITERIA AND ANALYSIS	**VALUE**	**DATA NEEDED**
FAVORABLE CONDITIONS IN 2 OF THE FOLLOWING THREE (I. - III.) ARE NECESSARY		
I. THE HEIGHT OF THE FLOOR PRICE (will be low if...)		
1. The seller feels a compulsion to sell		
(a) *The seller has estate problems* - This does not seem like a problem for a utility.	III	
(b) *The seller needs capital quickly* - This may not be capital for expansion (although it conceivably could). It may be money needed to keep the utility afloat. Even now there are a few utilities "near the brink." As competition continues there might be a desire to sell off transmission assets (which some believe to be worth more than their embedded cost) in order to stay liquid.	I	Financial situation of company

(c) *The seller has lost key management or sees no successors for existing management* - In a public utility this should not be a problem. An organization that large would likely look outside when management leaves if there are no capable successors on the inside. In fact, as the business is rapidly changing, a Board might want be inclined to look outside anyway. What is not included in Porter's framework, but is clearly applicable is that a utility might be forced by law to sell its transmission assets.	III I	Departures of key managers and the succession process New state regulations
2. The seller is not optimistic about its ability to continue to run the business.		
(a) *The seller perceives capital constraints to growth*- Look at the financial situation of the utility. Much of the capital of transmission lines is already invested and long-lived.	II	Company finances
(b) *The seller recognizes its managerial weaknesses*- Look for utilities where the upper management is all from a utility background and/or does not seem comfortable with the new competitive environment.	II	Profiles of management There public comments - perhaps even material in the company quarterly and annual reports.
II. IMPERFECTIONS IN THE MARKET FOR COMPANIES		
1. The buyer has superior information - A utility in the same region MIGHT have a better ability to know the potential for growth than those from further away. However, such benefits will likely be marginal. It may be because it has plans to increase the use of the transmission system for its own purposes.	II	Location *vis-a-vis* other bidders
2. The number of bidders is low - Look for assets that attract little attention.	I	General feel of interest
3. The condition of the economy is bad - Utility assets that are freed during an economic downturn would likely be more desirable. Especially since the freeing of assets may be due to regulatory reasons, rather than economic ones, they might be cut loose at "opportune" times for a potential buyer (provided that the buyer is in a sufficiently sound position to bid.)	II	Economic statistics
4. The selling company is sick - Look for companies on the verge of bankruptcy (or in bankruptcy).	I	Information about company health
5. The seller has objectives besides maximizing the price received for the businesses - Due to the regulated nature of the business and the focus that is now being placed on the industry, a utility that attempts to sell based upon intangible criteria would face serious scrutiny -- especially if the sale would have implications for the recovery of stranded investments.	III	

III. UNIQUE ABILITY TO OPERATE THE SELLER		
1. <u>The buyer has a distinctive ability to improve the operation of the seller</u> - A well-run utility would be able to have an advantage over other potential buyers given its successful experience in operating transmission systems. This would be mitigated in an ISO scenario, however -- especially if a utility does not even do O&M work on the transmission system. Also, an adjoining utility may be able to take advantage of economies of scale by purchasing a neighboring transmission system.	I I	Operational capability of "buyer" utility The existence of an ISO and what it is responsible for. Location of utility
2. <u>The firm buys into an industry that meets the criteria for internal entry</u> In Appendix D we found these to be: • *regulatory body open to competition -* • *region of rising transmission growth (due to transmission within or across region) -* • *Ownership of transmission capacity would facilitate a company's existing business -* • *where a new transmission entrant might be able to create a new market structure -*	 I I I I	 • PUC decisions • Statistics on transmission growth • Buyer's strategic plan and current situation • Buyer's strategic plan and current situation
3. <u>The acquisition will uniquely help a buyer's position in its existing businesses</u> - A close-by utility's assets could be particularly appealing, for PUHCA reasons and to create a larger transmission system. Also, if the "seller" utility had some transmission competencies that were lacking in the "buyer's" repertoire.	I	Location of utility assets vis-à-vis acquirer's assets. Competencies of the seller's generation assets vis-à-vis those in the buyers
IV. CAUSES OF "IRRATIONAL BIDDING"		
1. <u>The bidder sees a unique way to improve the acquisition target</u> - are there "logical" bidders because of a unique ability to improve the utility assets - particularly is there a utility in the region with an excellent transmission service history or that could take advantage of economies of scale?	I	Examine qualities of other potential bidders.
2. <u>The acquisition will help the bidder's existing business</u> - Is there a company, such as a natural gas company, that is seeking to become a "full service energy service" company?	I	Intentions of other companies in region

3. <u>The bidder has goals or motives other than the maximization of profit</u> - • growth potential - is there a market player in the region that sees transmission ownership as a key to growth - perhaps by having a steady revenue stream? • one-shot financial gain - is there is major user of electricity in a region that might see this as a way of lowering rates and creating an income stream? (The size and nature of such an investment, however, would make this somewhat unlikely.) • management idiosyncrasies - is there someone around who desperately wants to run a transmission system?	 I II III	 Intentions of other players. Intentions of major industrial users

I.4.2 Results

From this, we see that potentially beneficial asset-specific situations would include:
- When a utility is in poor financial shape.
- When divestment is forced by law (this does not come specifically from Porter's initial criteria.)
- When there are few potential bidders.

AND
- If the "seller" utility has some important competencies that the "buyer" utility lacks.
- If the transmission purchase would enable a utility to expand its transmission system (and take advantage of greater economies of scale).
- If transmission ownership would help facilitate sales from existing or future plants.

Desirable characteristics of the region where the utility assets are located include:
- where an entrant might be able to take advantage of a unique market structure
- region adjoining where the utility currently operates
- regulatory body open to competition
- region of growth for transmission demand (whether it be in or through the region)

Situations to avoid (or to be wary of excessive bids):
- A player in the region sees transmission ownership as a key to its growth.
- A utility that is an excellent transmission utility who might want to expand its service territory or who could benefit from economies of scale through a merger of transmission systems.
- Another company sees these assets as the ability to become a full-service energy services company or to lower its own electrical bill while creating an additional revenue source.

Appendix J
Supplemental Economic Issues Material

At the core of economics is the concept of efficiency.[1]

-- Harvey Leibenstein (1966)

J.1 INTRODUCTION

This appendix presents a number of sets of economics-related issues that are not central to this thesis, but were studied in its development, and in most cases, had some impact on the thinking of the document. This appendix is intended to lay out these issues for background/further reading purposes. It is not intended to flow from section to section, nor to lead the reader to a specific point, as should occur in the text of the thesis.

J.2 IMPORTANCE AND HISTORY OF ECONOMIC EFFICIENCY

Eminent MIT economist Paul Samuelson makes no attempt to understate the importance of economic efficiency to his discipline, "efficiency is a central (perhaps *the* central) concept in economics."[2] (emphasis original) Tersely defined, "efficiency means there is no waste."[3] While these statements may exalt the concept of economic efficiency, they are too abstract to use as a template for evaluating proposals for industry restructuring. Yet to develop a more tangible definition is not a simple task -- despite the importance of efficiency, a useful working definition for the concept is elusive. As Rowley commented on important economic concepts, "the closer our scrutiny, the more elusive and intangible the concept appears to be."[4]

The abstract concept of efficiency dates back to Paraeto, who posited that there is a "point of maximum ophelimity for the community."[5] Upon continual refinement on the part of economists, this definition has been sharpened and is manifest in the concept of allocative efficiency.

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[1] Leibenstein, 1966, 393.
[2] Samuelson and Nordhaus, 1985, p. 28.
[3] Ibid., p. 28.
[4] Rowley, 1973, p. 7.
[5] Paraeto, 1935, 1467. While quote is on page 1467, pages 1459 through 1479 are helpful in understanding Pareto's thinking on the issue, in terms of economics, sociology, and political economy.

> Allocative efficiency is present when all markets are in long-run competitive equilibrium. Each good is produced as long as consumers value it more than the alternative goods that might be produced with the same resources. No unit of the good is produced if a more valuable alternative must be foregone, and if any reallocation of resources toward differently goods or different combinations of goods ... would not benefit any one person without hurting someone else[6].

J.3 TECHNOLOGICAL CHANGE AND INTERNATIONAL CONVERGENCE

Recent studies have indicated that technological development is essential for the economic development of Third World countries. Political scientists and economists have long postulated a convergence theory -- that nations are gradually converging both economically and politically. In the political realm, the demise of the Soviet Empire and corresponding rise in democracy has leant credence to this theory. However, in the economic domain, the evidence for convergence is mixed at best. Although some countries have begun to "catch-up" to the developed ones, many more have not.[7] Recent research suggests that a major factor in the cases where less developed countries do catch-up (i.e. convergence) is the effective utilization of technology.[8]

J.4 FURTHER DISCUSSION OF INCREASING RETURNS

(This section continues and expands upon the discussion that occurs in Section 9.5.1). If there is truth in the theory of increasing returns, some serious problems and dilemmas result. The first of these is that once a network technology is chosen, it is hard to uproot. This does not pose a problem if the "superior" technology (both in the short- and long-term) is chosen. However, if it is not -- either because an inferior technology is explicitly chosen over a superior one, or because a superior new technology develops later -- there are negative efficiency consequences. As David and Bunn observe,

> Where network technologies are involved, one cannot justifiably suppose that the system which has evolved is really superior to others which might have been developed further, but were not. Nor should we comfort ourselves with the presumption that the 'right economic reasons' were responsible for the emergence of a technological system that has in fact turned out to be superior to any of the alternatives available.[9]

The implication of this discussion is that future technological changes in electric transmission systems will not be deterministic -- the most efficient technology need not be the one selected for use. This is a troubling finding. But one might ask, 'What would the

[6] Gwartney and Stroup, 1987, 442.
[7] Verspagen, 1993.
[8] Boyer, forthcoming.
[9] David and Bunn, 1988, 169-170.

potential consequences of choosing an inferior technology be'? and 'Hasn't the electric power industry been a leader in productivity improvements'?

Although perhaps extreme, the early struggle between Westinghouse and Edison over the use of AC or DC current (essentially a fight to "lock-in" their technologies) is very illustrative.[10] . Westinghouse eventually won this struggle and AC became the industry standard. The consequence of this "victory" has been enormous -- the choice of AC over DC profoundly influenced the future of the industry.

> Edison's low-voltage, DC system would have required many small generating stations and short distribution lines. The high-voltage Westinghouse AC system promoted development of long-distance transmission networks that deliver electricity efficiently from large, remote power plants. The economies of scale involved led directly to the emergence of today's vertically integrated utilities.[11]

While traditional economists would argue that this outcome proves that the "invisible hand" worked, network economists would argue that it was the result of good technology and strategy on the part of Westinghouse, as well as luck in developing complementary goods. They would argue that Edison winning the battle is not an inconceivable outcome. For example, had the development of a practical AC motor taken a decade longer than it did, "the scales" might have tipped to DC (for which there was a functional DC motor). Although this story elucidates the potential risks that are at stake in network/increasing returns technology adoption, David and Bunn also use the story to present a more comforting finding. They argue that one of the events that disturbed a delicate balance of market advantages based upon heterogeneous user needs[12] was the introduction of a gateway technology -- the rotary converter -- that made the demand needs more homogenous, thus making the lower transmission cost of AC current a relatively more valuable characteristic. Thus, the development of gateway technologies[13] may push the balance towards superior technologies.

Nevertheless, the basic trade-off between improved technology (and its benefits today) and the potential for future technological change presents a paradox: one could (at least in theory) delay adoption of a network technology in order to prevent making an inferior choice; but doing so would delay the use of improved technologies. It is analogous to buying a personal computer in today's rapidly changing technological environment: one

[10]See Appendix B.2 for more on this.
[11] Stahlkopf, 1995, 33.
[12] David and Bunn, 1988, 198.
[13] Incentives should exist for the development of these gateways by those both within and outside the industry.

must decide when she will buy it with the understanding that she will see a better model on sale for a less expensive price in a month. The situation that results, according to Paul David, is that "where there are alternative emerging network technologies to choose among... the public goods problem (the need for others to select it as well) tends to retard the adoption of any one of them."[14]

Having laid out the issues, a significant problem remains, how do we ensure, through institutional structures, that inferior technologies will not be chosen? The answer is that in many ways it is an impossible task to accomplish.[15] However, one conceivable way to reduce the incentives for this to occur would be to divorce the financial interests of those choosing the technologies used with those who develop them. The Edison/Westinghouse battle vividly demonstrates the extremes to which people are willing to go in order to protect their financial interests. As long as transmission lines are not owned by companies that develop transmission equipment, some of the risk that a user would adopt an inferior technology is eliminated.[16] Secondly, some suggest that this is not an issue at all; that while network effects are pervasive in the economy, there is little evidence that network externalities exist, or if they do, that they lead to only minor distortions such as over- or under-supply of a good, rather than the selection of inferior technologies.[17]

J.5 ECONOMIC RESEARCH REGARDING TECHNOLOGICAL CHANGE

We now discuss a potpourri of economic research related to technological change.

J.5.1 Large-Scale Systems

One area of study that is particularly relevant for transmission systems regards technological change in large-scale systems. In his extensive research in this area, Paul David has identified several barriers to new technology adoption inherent in technologies with characteristics similar to that of transmission systems.

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[14] David, 1986, 385.

[15] Katz and Shapiro argue that "we are [still] far from having a general theory of when governments intervention is preferable to the unregulated market outcome," with regard to systems competition and network effects. Source: Katz and Shapiro, 1994, 113.

[16] Although this statement is not entirely correct. Such a conclusion is consistent with Katz and Shapiro's model that finds that in the presence of no sponsors, the technology that is superior today (at the time of adoption) will be the one selected. What it ignores, however, is the situation where competing standards are BOTH sponsored, which Katz and Shapiro argue leads to long-run superior adoption. However, if there are asymmetries in sponsorship, the inferior technology has a chance of being adopted. Source: Katz and Shapiro, 1986.

[17] Liebowitz and Margolis, 1994, 149.

> First, in projects characterized by larger fixed costs for state-of-the-art plant and equipment, where offsetting savings in variable cost become significant only at high throughput rates, a critical issue is the scale of output that the enterprise can anticipate maintaining with the production facility in question.[18]

This would indicate that new transmission technologies would be more likely to be adopted if they would *increase* the scale economies of the transmission system -- a trend that is at odds with what is occurring in generation and with the future concept of "distributed generation."[19] Secondly,

> While an old plant may be technologically obsolescent, prevailing product prices in the industry may permit variable costs to be covered and so make it rational for profit-maximizing firms to defer the date of capital replacement. New technologies are placed at a distinct disadvantage in competition with their predecessors whenever they come embodied in or are technically interrelated with indivisible capital goods that will burden the used with heavy fixed-cost charges. This is especially so when the old techniques are embedded in extremely durable physical plant with low maintenance requirements. ... Durable facilities surviving from earlier epochs may pose barriers to the introduction of best practice methods that, in pathological cases, cannot be surmounted by the workings of normal competitive market processes."[20]

Both of these findings are disturbing as they suggest that there is a serious inherent bias in large systems -- such as electric power transmission -- against revolutionary changes in technology.[21]

This discussion, and the one that preceded it, have potentially disturbing consequences for technological development in transmission. This research should give pause for thought to those economists have held a comforting assumption that the "invisible hand" will steer the market and create a world of maximum efficiency.[22] At the same time, however, these economic theories are still relatively nascent and must be treated with at least some degree of caution.

J.5.2 Number and Size of Firms

J.5.2.1 Economic Theory and Studies

A question of significant interest to economists is: Do large firms in a relatively uncompetitive environment spawn more technological innovation than smaller firms that

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[18] David, 1986, 381.
[19] Lamarre, 1993.
[20] Ibid.
[21] For this purpose, we will define this as a technology that would replace a previous one before the latter was physically obsolete.
[22] David and Bunn, 1988, 169.

exist in a highly competitive environment? This question has arisen from the "Schumpeterian hypothesis" which essentially states:[23]

- There is a relationship between innovation and monopoly power with its concomitant above normal profits; and
- Large firms are more than proportionately innovative than small firms.

In Schumpeter's words,

> As soon as we go into details and inquire into the individual items in which progress was the most conspicuous, the trail leads not to the doors of those firms that work under conditions of comparatively free competition but precisely to the doors of the large concerns -- which, as in the case of agricultural machinery, also account for much of the progress in the competitive sector -- and a shocking suspicion dawns upon us that big business may have had more to do with creating that (improved) standard of life than with keeping it down.[24]

Similar sentiments were expressed by John Kenneth Galbraith;

> A benign providence who ... has made the modern industry of a few large firms an almost perfect instrument for inducing technical change. It is admirably equipped for financing technical development. Its organization provides strong incentives for undertaking development and putting it into use. The competition of the competitive model, by contrast, almost completely precludes technical development.[25]

Galbraith went on to say, "there is no more pleasant fiction than that technical change is the product of the matchless ingenuity of the small man forced by competition to employ his wits to better his neighbor. Unhappily, it is fiction."[26] These views were provocative since they were in direct opposition to the neoclassical economics of their day. As a result, a plethora of studies have examined the relationship between firm size and R&D effort.[27]

The results of these have been mixed and much research is still needed to be done in the area. Good surveys of the literature include: Kamien and Schwartz,[28] for early research; and Cohen & Levin,[29] for more recent research. Although no crystal-clear theories have emerged, several general findings have gained some credence. The first is that firms that are small/medium-sized are the best equipped to make innovations -- that after a relatively small threshold size, there is a diminishing returns to inventive productivity with respect to firm size.[30] Similarly, those industries with moderate competition are more conducive to innovation than those that have low or high concentration.[31] With time there has also

[23] Kamien and Schwartz, 1982, 22.
[24] Schumpeter, 82, 1962.
[25] Galbraith, 1952, 91.
[26] Ibid.
[27] Acs and Audretsch, 1991, 52.
[28] Kamien and Schwartz, 1982.
[29] Cohen and Levin, 1989.
[30] Acs and Audretsch, 1991, 55.
[31] For example, see: Futia, 1980.

become a growing belief that issues such as consumer tastes, technological opportunity and appropriability are also of significant importance in determining the innovativeness of an industry.[32] In this view, firm size is only one variable (perhaps even a relatively unimportant one).

J.5.2.2 Application in Semiconductor Industry

In the forum of applied policy, this debate has been especially important and lively during 1980s and 1990s in several industries -- most notably the semiconductor industry. As the Japanese rapidly replaced the United States as the dominant nation in this "industry of the future" during the 1980s, there was a large block of opinion that supported a consolidation of the American industry. It was felt that in the battle of numerous small, entrepreneurial American Davids against the Goliath of Japan Inc.'s oligopoly of vertically integrated electronics corporations, David would not win.[33] However, the resurgence of the American industry, which has been fueled by entrepreneurialism and technological advance, has shifted opinion on the topic, even among those who once were strong proponents of the large-company model.[34] Furthermore, the paradigm of technological advance through "predictable" improvements in DRAM production[35] has been supplanted by one by which technological advance occurs in a more diffuse fashion. (This has occurred, at least in part, because of the significant increases in cost of cutting-edge manufacturing equipment. This financial necessity means that the whole industry must, to some extent, innovate together.)[36]

J.5.3 Firms with R&D Capabilities

Closely related to the discussion on firm size and the number of firms in an industry is the concept of some firms possessing special R&D characteristics. One group that agrees with this conclusion are in the Schumpeter camp -- monopolies allow for profits that can be put back into research and development. A classic example of this is discussed in the chapter on AT&T. As Vietor observes,

[32] Cohen and Levin, 1989, 1095.

[33] For example, see: Lester, forthcoming.

[34] A classic example of this is Charles Ferguson, who renounced his earlier thesis that the United States semiconductor industry must become part of a tightly-woven, vertically integrated industrial network (see: Ferguson, 1988 and Ferguson, 1990) in his 1993 co-authored book: *Computer Wars: How the West Can Win in a Post-IBM World*. In this, he described these previous pieces as: "The case for pessimism for American computer-makers; superseded by the discussion here." Source: Ferguson and Morris, 1993, 260.

[35] This was the mind-set that dominated the industry in the 1980s and which lead to such great concern when the United States was obliterated in this technology in the mid-1980s. See, for example: National Advisory Committee on Semiconductors, 1989, 9-10; and Dertouzos *et al*, 1989, 250.

[36] Barrett, 1996.

> In basic science and engineering, Bell Laboratories was an extraordinary innovator. Only the protected earnings produced by AT&T's regulated monopoly made such a research effort possible.[37]

IBM (Watson Labs), RCA (Sarnoff Labs), and Xerox (PARC) are three more examples of large corporations who possessed incredible research facilities. A common thread in each of these labs is that they have faced cut-backs as their parent companies faced stiffening competition.[38] Those that argue this viewpoint could also find support for their claims in the electric utility industry. In 1993 alone, electric utility R&D has dropped by one-third, with those cuts coming most from states at the vanguard of the competition movement.[39]

In another camp are those who argue that smaller, more nimble firms posses more energy, less bureaucracy, and more incentives (one product failure could spell imminent doom for the company) than larger firms and are therefore more innovative. Such a view is laid out in Ferguson and Morris' Silicon Valley model which is discussed in *Computer Wars*.[40] Here the concept of a firm is more fluid.

Regardless of what type of an environment these firms operate in, there do appear to be some firms that have a culture for innovation -- and these cultures cannot be replicated as efficiently through other research arrangements, such as cooperative research ventures (although they can be complimented by them).[41] This is because there are obtaining and adsorption costs.[42] When a firm has a solid R&D base, the cost of absorbing research information is lower because the firm is continuously monitoring and assessing new technologies.[43] As a result, firms with advanced R&D capabilities are able to have more rapid and less expensive technology transfer -- they can take new ideas and discoveries and turn them into product innovations more efficiency -- than those who do not posses them. There are two implications to this. The first is that if these capabilities are lost, they are not readily emulated in through other mechanisms, such as research consortia, etç. Second, while one might think that stronger firms have less to gain by participating in consortia, the

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[37] Vietor, 1994, 319.

[38] Sarnoff labs, in fact, was given away to a private firm when General Electric bought out RCA in 1987. Source: Dertouzos *et al*, 1989, 227.

[39] "High Noon for R&D," 60.

[40] Ferguson and Morris, 1993.

[41] This has been seen recently in the semiconductor industry where SEMATECH, a research consortium, has played an important, but intangible role in the industry's revival. While none of the participating firms are willing to credit SEMATECH with market share gains, almost all feel that they have benefited from it. Sources: Hamilton, 1991, 23; and "Uncle Sam's Helping Hand."

[42] For example, a 1976 study by Teece found that 19% of the costs (of 26 technology-transfer projects) was accounted for by: pre-engineering information exchanges, engineering costs associated with transferring the necessary designs, R&D personnel, and pre-start-up training, learning and debugging. Cited in: David, 1986, 382.

[43] Mowery, 1983.

opposite may be true. By being able to more rapidly utilize technological advances than less sophisticated competitors, they may very well have more to gain. This conclusion was demonstrated in a National Science Foundation program evaluation regarding cooperative research,[44]

> The more substantial participation has come from the large research-oriented companies that can understand and use the research outputs of the cooperative efforts. Companies with little research background, such as the utilities and furniture companies, are traditionally conservative with respect to new technology and are traditionally dependent on their suppliers for whatever changes they adopt.[45]

The last sentence indicates that this discussion may not be significantly important to our discussion of the transmission industry, since individual utilities have done little individually in terms of significant technological advances in transmission technology. As a result, the potential for damage to the research capabilities of transmission utilities during restructuring should not be a primary consideration in developing proposals.

J.6 HISTORICAL IMPEDIMENTS TO TECHNOLOGICAL CHANGE IN THE ELECTRIC POWER INDUSTRY

J.6.1 Earliest Development: Chicago vs. London

Thomas Hughes[46] contrasts the rapidly growing, technologically advanced, and low-cost Chicago electric power system prior to World War I with London's relatively backward system. For example, the per capita electricity use in Chicago was approximately 3 times that in London in 1913.[47] The advanced state of Chicago's system was due in large part to the efforts of Samuel Insull. In the mid-1890s, Chicago's electricity supply bore little likeness to the system that would evolve over the following two decades. Between 1890 and 1905, as many as 47 franchises were granted to provide electricity to part or all of Chicago.[48] In the midst of this chaotic situation, Insull was among the first to understand the large-scale systemic benefits of an electric power system. Thanks to a combination of engineering and economic skills, Insull recognized the value of load diversity and the fundamental economic importance of load factor. He also appreciated the benefits that accrue from taking advantage of continuously improving technologies and from generation scale economies. These economic and technological factors acted synergistically to improve the economics of the industry while encouraging technological advance.[49] In addition to his economic and engineering prowess, Insull also appreciated the importance

[44] This is with regard to the 1970s University-Industry Cooperative Research Centers Experiment.
[45] Cited in Mowery, 1983, 35.
[46] Hughes, 1983, 201-261.
[47] Hughes, 1983, 228.
[48] Wilcox, 1910, 143.
[49] U.S. Census, 1902, 28.

of politics in system-building. With this understanding, Insull undertook a consolidation of the disparate clusters of generators and load into a true electric power system. After outmaneuvering a group of local cronies, he was able to purchase a 50-year service franchise for Chicago. With the franchise in hand, and having observed the experiences of other "utility" industries in the corrupt Chicago environment, Insull realized that in order to maintain a stable electric system, the state should become responsible for regulating service and rates. After a 10 year fight, he was able to persuade the National Electric Light Association (NELA) to support the concept of state regulation in 1907. That year, three states established regulatory agencies, and 33 states had such bodies by 1916.[50] With regulatory authority in the hands of the states, electric companies were then free to grow and take advantage of economies of scale, exempt from the fragmentation and potential corruption of municipal regulators.

In contrast to Chicago, the governing structure of London was balkanized. The authority for governing utilities was both horizontally and vertically complicated. There were at least three levels of local government to contend with, with forces at the lowest level being least amenable to the creation of a system -- each borough government adamantly maintained control over its area. Within the domain of the London city council, there were 28 boroughs and twenty-eight utilities,[51] and in Greater London area there were 65 utilities. Hughes comments, "London's pluralistic and historic administrative structure deeply affected the growth of the electric supply industry there."[52] This structure had a deleterious effect on the development of new technology. The best example of this was the failure of the Deptford power station. This station was to employ the latest technologies and to be the first English attempt at taking advantage of economies of scale. However, the Balkanized political environment reduced the size of the plant's franchise territory and allowed for competition within it. Since it was a "leading edge" plant, Deptford experienced technical glitches. As a result, three-quarters of its customers switched to competing, "more reliable" suppliers.[53] Despite being "considered as the forerunner of all modern central power-stations,"[54] the plant eventually failed due to lack of financial support from its investors,[55] and with the plant, so too did England's attempt to stay at the technological frontier in electric power systems. While in the short-term, the ability of customers to access alternative power supplies was efficacious; in the long-term loss -- in terms of cost

50 Hyman, 1988, 68.
51 Hughes, 1983, 236.
52 Ibid., 229.
53 Ibid., 145.
54 Singer *et al*, 1958, Vol. V, 200.
55 This was because the plant had lost most of its customers

(the plants that survived were small and out-of-date) and national technological leadership -- was high. More than a decade later, in 1905, an attempt was launched to unify the London system (i.e. economies of scale were still not being utilized). Despite the persuasive technical arguments for unifying the system, the strength of the local governments prevented it from happening. As a result, in 1913, while power for the cities of Chicago and Berlin was supplied by 6 central stations apiece, 64 stations supplied power to London.[56] Between the late 1880s and early 1910s, in large part due to its Balkanized governance, London had gone from being one of the world's most advanced cities to being one of the laggards (in terms of electrification).

The most significant lesson from these stories is that in order for a system to operate efficiently and take advantage of technological opportunities, the bodies that regulate the system should be composed in such a manner that they can regulate with a system-wide perspective.

J.6.2 <u>Market Structure Studies In Electric Power</u>

Joskow and Rose[57] found that there were significant economies of scale and experience effects associated with generating unit construction costs. These economies are due, at least in part, to the recognition that "power plants are not standardized pieces of equipment manufactured in factories, but are brought into operation as a consequence of large-scale construction projects."[58]

Several years later, the same duo (Rose and Joskow) examined the impact of firm size on the adoption of two types of new generation technologies in the pre-competitive era of the electric power industry (1960-1980).[59] Specifically, they studied the adoption of coal-fired high pressure and very high pressure supercritical units. These were essentially two generations of improvements on the industry standard technology (as opposed to revolutionary technologies). Based upon their study of power plant data they made two significant and relevant conclusions:[60]

- Larger firms were more likely to adopt the new technology units. As they note, larger firms have more opportunity for incremental capacity needs, and since most plants were built to fulfill those needs (as opposed to replacing old capital), larger firms would have more of an opportunity to purchase new

[56] Hughes, 1983, 257.
[57] Joskow and Rose, 1985.
[58] Joskow and Rose, 1985, 2.
[59] Rose and Joskow, 1990.
[60] Rose and Joskow, 1990, 371

generation plants. Hence, they corrected their results for this fact and still found that larger firms were more likely to opt for new technologies.

- Investor-owned utilities were more likely to adopt new technologies than were municipally-owned utilities or cooperatives; which, as they point out, is consistent with the fact that utilities are more involved in industry R&D organizations and activities.

These studies would indicate that consolidation in the industry would be beneficial for the adoption of new technologies. However, the generation business has changed greatly since these studies were conducted. The introduction of new generation technologies has undermined the applicability of their conclusions in the generation segment of the industry. The residual lesson may still be applicable for transmission, nevertheless (as it retains some natural monopoly characteristics).

J.6.3 Accounting and Tax Rules

Financial (taxes and accounting) rules employed by the Internal Revenue Service, regulators, and firms themselves can also serve as incentives or disincentives for the adoption of new technologies. The discount and hurdle rates that firms use as their basis in determining the economics of specific transactions and the tax rates and codes play a major role in the investment decisions of firms.[61] With regard to tax incentives, in general, when investments are depreciated over a short period of time they are more attractive than when they are depreciated over a longer period of time.[62] The determination of how long each particular investment can be depreciated (for tax purposes) is made by the regulators who prepare the tax codes. Given the long-lived nature of transmission investments, these tend to be depreciated out over many years. Such practice, then, compounds the incentives for transmission owners to keep this equipment even in the face of new technologies. As a result, one mechanism for assisting technological change would be for depreciation schedules, etc. to treat transmission equipment that embodies technological innovation with more favorable terms than traditional equipment.

Closely related to tax depreciation is the capital recovery period of utility investments, the period of time over which the fixed costs of a utility investment are paid for by the rate-payers. This too is not determined by firms, but by regulatory agencies. The longer period over which this occurs, the greater the disincentives for their replacement by technologically superior equipment. Vietor noted this with respect to AT&T. While Bell

[61] Park and Sharp-Bette, 1990, 129; and Hatsopoulos and Poterba, 1992.

[62] This is due to the diminishing value of money over time and opportunity costs associated with not being able to use money.

Labs produced cutting edge technology, it was not quickly used in the system because "regulatory accounting discouraged AT&T from modernizing its network quickly."[63]

The internal accounting decisions made by firms can also have a great impact on investment decisions. The minimum rate-of-return that a company uses to calculate the economics of potential investments (hurdle rate) and the recovery period over which it intends to pay for them have significant impacts on technology adoption. The relatively low hurdle rates of Japanese firms are one explanation of why Japanese companies persisted in the long-term development of some high technology products that American firms had pioneered but then abandoned.[64] Within the American electric power industry itself, research done on the adoption of electric generating capacity in the 1970s indicated that the selection of accounting practices with regard to capital and operating costs made a substantial difference in the relative attractiveness of nuclear, coal, and solar energy generating sources.[65] Given that any improved transmission technologies will replace those that currently have only about 3% power losses, it is quite likely that the benefits of new technology will be marginal -- and thus will make adoption worthwhile only over a long time horizon. If transmission firms operate on a short time horizon, not surprisingly, such technological advances would not appear attractive (and therefore would not be adopted).

The lesson from this discussion is that new technologies are most likely to be adopted if tax deprecation and rate recovery regulations allow for financial recovery in a relatively rapid manner, and if firms employ low hurdle rates and have long-term vision.

J.6.4 The Slow "Productive" Use of Electric Power

In recent years, the delay in the "productivity-enhancing" use of information technology (IT) has been one of concern and speculation for many economists.[66] Robert Solow is reported to have said of the 'productivity paradox', "(w)e see the computers everywhere but in the productivity statistics."[67] Paul David has compared the current situation in IT to that which occurred at the start of this century with regard to electric power.[68] While some engineers recognized the potential utility of electricity in manufacturing, it was not until

[63] Vietor, 1994, 319.
[64] Dertouzos *et al*, 1989, 55-56, 217-231; and Hatsopoulos and Poterba, 1992.
[65] Spinrad, 1980.
[66] For example see "International Conference on the Future of Industry in Advanced Societies, Conference Report," 17-20. However, after years of lagging productivity, there is some hope that these new technologies are beginning to significantly improve productivity. Source: "Riding High."
[67] Cited in David, 1990, 355.
[68] David, 1990.

organizations (and plants) were reconfigured to effectively utilize the new technology that the pay-offs from the use of electricity were realized. The old factories were not immediately replaced for two reasons. First, they represented large capital expenses and it was not economical to replace plants that were still physically undepreciated. Second, the physical and organizational concept of a factory needed to be redesigned for the significant benefits of the technology to be realized. In an "old' mechanical factory, keeping production steps in close proximity and building the factory vertically were essential given the limited distance (without substantial power-loss penalty) that mechanical power trains could operate. In contrast, electricity allowed for distributed power supply, which allowed for optimization in terms of materials handling and process flow. Therefore, until the distributed benefit of electricity was realized, a factory that replaced water power with electricity would have merely traded one similar technology with another and few gains would have been realized. It was through diverse experience, industrial growth, and entrepreneurship that methods to harness the full potential of the technology were found.

When one examines the electric transmission industry segment at the dawn of the Twenty-First Century, the situation is slightly different than with the harnessing of electric power. In the latter case, those who had to adopt and adapt the new technology were a plethora of diverse, entrepreneurial end-users. The ones who were successful built upon the experience of others, recognized and developed the alternative organizational structures, and did so in the context of growing markets. In contrast, in transmission systems of the future, ownership will likely stay concentrated in the hands of regulated utilities (or agencies) and construction will be limited (due to barriers to construction and low load growth rates).

The lesson from this discussion is that the industry structure should be developed so that transmission companies have incentives not to atrophy. How this is created, however, is not readily apparent, although competition, at least in limited segments of the industry, would appear to be one mechanism.

J.6.5 Does the Current Deregulation Create Disincentives for New Technologies?

One could look ahead and ask whether the current experience with deregulation, which has resulted from technological innovations in generation, could stymie innovation in transmission. After having witnessed how their industry has been transformed by revolutionary generation and information technologies, it could be speculated that in the future, those utilities which operate in segments of the industry that remain uncompetitive will be less than enthusiastic supporters of new revolutionary technologies in their industry segments. While pure speculation, it does not seem unreasonable to at least suspect that utilities would not quickly embrace a revolutionary technological change in transmission because of the potential erosion of their monopoly position that could result.

J.7 TECHNOLOGICAL CHANGE AND THE IMPORTANCE OF EXAMINING A DYNAMIC MARKET

In the past several sections we have discussed the importance of technological change. With that being the case it should be obvious that when we examine the future of the industry, we should not look at a static picture, but one that is dynamic, incorporating changes caused technological advance, market evolution and political changes.

J.7.1 Implications for Economic Analysis

Yet, as Klein notes, many of the principles of economics are based upon a static view of the world.

> The classical theory of competition can not explain how progress comes about because it is premised on the assumption of a completely static world in which firms act on the basis of perfect knowledge. Indeed, if firms acted as if their knowledge were complete, no progress could ever occur.[69]

Schumpeter adds, "capitalism, then, is by nature a form or method of economic change and not only never but never can be stationary."[70] Rosenberg comments on the implications of this statement, "

> It involves ... nothing less than the rejection of the competitive ideal itself, as that ideal is enshrined not only by in economists' models but also in decades of government regulation... In this view, textbook competition is not an ideal to be pursued.[71]

What should be taken from this for the purpose of this thesis is that we should not limit our understanding of the concept of efficiency to criteria grounded in the current state of the industry.

J.7.2 Implications for Policy Development

Just as economic analysis should not be limited to static assumptions, neither should policy decisions. As new technologies, business strategies, and policy decisions take on a life of their own, the future is guaranteed to be different than both the present AND the forecast.[72] In our discussion on the break-up AT&T we see how the technology employed in a deregulated long-distance market was not that which was anticipated when the break-up

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[69] Klein, 1977, 9.
[70] Schumpeter, 1962, 82.
[71] Rosenberg, 1994, 51.
[72] deNeufville, 1990, 273.

was ordered. Within the electric power industry, we have seen how PURPA differed greatly from its intent -- President Carter's National Energy policy was not intended to promote competition, but yet it set a dynamic process into motion that now leaves us on the threshold of a competitive industry. As technology improves and is placed into continually evolving contexts (technical, policy, and business strategy) the possibilities for its use constantly changes. When these new technologies are combined with intellectual advance, the ability to harness technology is increased in unimaginable ways. It is important, then, that decision-makers not presuppose technology in developing a system, but rather, as Rosenberg concludes,

> policy should be constructed to ensure that the technological path *is as flexible as possible*, that resources are channeled toward those institutions which consistently provide large social benefits, and that viable economic opportunities are available to those who push out the technological frontier.[73] (emphasis original)

J.8 CONTRACTS AND FIRMS

As mentioned previously, the "old" industry was premised upon the belief that electric power production and delivery constituted an integrated natural monopoly. The restructuring that is occurring today is largely a result of those assumptions being undermined, at least in parts of the industry. One of the primary expected outcomes of restructuring is that services which are currently bundled -- electric transmission, distribution, and generation (and perhaps even finer graduations of these), will become unbundled. When this occurs, instead of being provided by one company, where internal decision-making and ordering guide the production process, these services will be provided through a series of contracts. With that being the case, let us examine the concepts of firms and contracts.

J.8.1 The Concept of a Contract

In a market economy, contracts are consummated under four primary circumstances:[74] fundamental and complex uncertainty, asset specificity, infrequency of interchange, and likelihood of opportunistic behavior. Contracts can, in turn, be divided into four types:[75] planning, promise, competition, and private ordering. While contracts provide security, and thus allow the economy to function, they also create transaction costs, which are the economic equivalent of friction in a physical system.[76] These are the costs of entering into

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[73] Rosenberg, 1994, 228.
[74] Joskow and Schmalensee, 1983, 27.
[75] Williamson, 1986, 177.
[76] Williamson, 1986, 176.

contracts, such as negotiations expenses, and the expenses of maintaining them, i.e. monitoring compliance, enforcement, and opportunity costs.

If the electric power production process were to be broken down into a series of contracts, physical and financial contract terms would likely need to be written for the following functions:[77]

- Cost of energy;
- Cost of transmission;
- Power quantity ;
- Reliability;
- Duration (of contract);
- Delivery points; and
- Contingencies.

In addition to having contracts written for these items, the contract process must be auditable (especially with regard to congestion charges and disallowed potential transactions due to congestion)[78] and it must be made impregnable to tampering. White collar crime is a problem in any industry and power stealing could become a sophisticated and lucrative endeavor due to the intimate relationships between competitors on an electric power system. Consequently, tools would need to be developed to protect against "power theft" if contracts would become the medium by which the industry is run.

The market seeks to find the path of least resistance, in this case, the lowest transaction costs (while considering the risks of not having contracts). Because different arrangements and types of "products" have different characteristics, the contracts (and transaction costs) that result can vary greatly. It must be realized that contractual parties might be in different positions *ex ante* than *ex post*. In the case of electric power, a utility or IPP is in a much different position vis-a-vis a potential buyer before it signs a contract than after it builds a plant. *Ex ante*, they are in relatively equivalent positions. However, after the large investment has been made, a utility/IPP is in a subordinate position. As a result, a generator seeks a guarantee from customers to protect its investment. In the old regime this took the form of the regulatory compact. Today, IPPs seek this security through long-term sales contracts.

In the past, the potential transaction costs in the electric power industry were very high. As a result, as we discuss below, the industry was organized to eliminate the need for many

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[77] Tabors, 20 October 1995; and Joskow and Schmalensee, 1983, 113-114.

[78] Such concerns are already being addressed. For example, Coopers and Lybrand is continually auditing an ABB project to write a load flow optimization program that is being designed for use in a competitive market. Source: Masiello, 19 October 1995.

contracts (and the transaction costs that accompany them). However, rapid advances in information technologies have made possible transactions that were unthinkable a decade ago and have greatly lowered the transaction costs in some parts of the industry. For example, there are at least seven commercial real-time information systems for transmission that are currently available, most of which can be run on a Microsoft Windows™ system.[79] Therefore, from a transaction costs perspective, the industry's coefficient of transaction cost friction is becoming smaller, and is expected to continue to do so as metering equipment advances and prices continue to fall.[80]

The implicit assumption in a perfectly competitive market is that transaction costs do not exist, which has implications for industry structure. Oliver Williamson comments, "if transaction costs are negligible, then the organization of economic activity is irrelevant, since any advantages one mode of organization appears to hold over another will simply be eliminated by costless contracting."[81] However, when they are not negligible, such as has been the case in the electric power industry, it is often more efficient to have disparate economic activities organized into one entity, a firm.

J.8.2 The Concept of a Firm

A firm exists when it is "more economical to organize and operate processes through central control of some kind rather than through the market."[82] This is because the operation of the market has transaction costs associated with it[83] and in cases where these costs are high, an entrepreneur replaces multiple contracts with singular contracts with each of his employees.[84] Thus, within a firm, resource allocation decisions are made through command-and-control, not market mechanisms. In special cases, there can be economies of integration within a firm. However, physical connections do not necessarily demonstrate economies of integration.[85]

Even when there are economies of integration, these can be off-set by the benefits of competition. For example, in the natural gas industry Order 636 (which required the unbundling of pipeline service and gas sales) eliminated the economies of integration that had been present within firms for decades. For example, instead of being able to call the

[79] Source: "Real Time Networks: A Peek at Tomorrow's Transmission Market."
[80] Willis, 20 October 1995.
[81] Williamson, 1979, 233.
[82] McKie, 1970, 11.
[83] Coase, 1952, 338.
[84] Ibid., 336-337.
[85] McKie, 1970, 12.

pipeline operator on an inside line or walk over to his desk, an affiliated sales agent now must obtain pipeline information through the same mechanism as outsiders. This change was made because the benefits of competition came to outweigh the benefits of integration.

The electric utility industry took on its vertically-integrated form because it was believed to be less expensive to have one firm running generation, transmission and distribution functions. One reason for this is that large amounts of information must be known on a real-time basis to keep an electric power system together. Until recently, when information technologies have made the sharing of information much simpler and less expensive, the cheapest, and perhaps only way for an electric power system to be operated was through a centralized firm. However, as in the case of the natural gas industry, today it is widely believed that it would be more efficient to incur the higher transaction costs of unbundling, because they would be offset by increased efficiencies from a more competitive market. One of the challenges of deregulation will be to ensure that the replacement of internal control mechanisms with contract ones does, in fact, increase efficiency. Because of the opportunism that could arise in some cases (i.e. if some functions were unbundled) it would be possible that the contract written to protect against it (the opportunism) would result in *de facto* re-integration through contract, which would likely be less efficient, since it would include transaction costs.[86]

J.8.3 Efficiency Lessons

From this discussion we can draw two efficiency lessons:

- For those parts of the industry which become disintegrated, mechanisms for a sufficient contracts (that replace the vertical linkages) should be developed; and
- While retaining the necessary contract protections, market structures should be designed to economize on transaction costs, and remain sufficiently flexible to adjust to new technologies, while preventing re-integration through contract.

J.9 MARKET POWER, TRANSMISSION, AND EFFICIENCY

At least two types of market power abuse could be perpetrated by transmission owners. A utility that owns transmission capacity and excess generation capacity could attempt to block a potential wholesale power transaction (where a competitor would provide generation service) either by refusing transmission service (although EPAct has granted the FERC the authority to prevent this) or by charging rates that make the transaction uneconomical.[87] Another form of market power exists when the transmission owner is the only conduit through which a transaction can occur. Except for the case when the

[86] See: Joskow and Schmalensee, 1983, 126-127.
[87] FERC, 1989, 72; and Rogers, 1994, 6-7.

transmission owner's affiliated generators would be hurt by the use of its lines, the transmission owner has an incentive to allow a wheeling transaction to occur. Despite this incentive, if it were to operate unchecked by regulation, the transmission company would be able to price the service in a way that captures most of the economic rent in the agreement. Although this would not diminish overall allocative efficiency, it would be a deterrent to investment in new generation facilities (since the generators would realize few of the profits from their investment and would be in an inferior negotiating position throughout the life of the plant).[88]

J.10 MORE TRANSMISSION PRICING ISSUES

Let us now discuss a number of pricing issues. In doing so, we should note that transmission pricing issues are currently a topic of hot debate. This discussion is not intended to look at the issues in depth, but rather, to discuss them in brief.

J.10.1 Reactive Power

Despite the attention that wire resistance-induced transmission line losses receive, reactive power losses are significantly larger in certain circumstances. William Hogan argues that reactive power flows should be incorporated into electricity marginal cost pricing in order to ensure that appropriate price signals are sent.[89] Such price signals would work to ensure that the true costs of transmission would be borne by all who use the grid and would provide market participants with proper incentives for installing reactive power support. Not all analysts believe that reactive power pricing is necessary for an efficient system, however. This counter view is taken by Edward Kahn and Ross Baldick, who claim that these costs are relatively minor, and not worth taking into account.[90]

J.10.2 Ancillary Services Pricing

As mentioned in a previous chapter, ancillary services are those transmission system functions that are essential for maintaining its reliability. In a decentralized environment, market-clearing electricity prices will not necessarily be economically or technically efficient unless the marginal costs of ancillary services are billed in a non-subsidizing, transparent, temporal, and spatial manner.[91] As they are not the usable megawatts that can purchased and used by a customer, one can not safely assume that they will be paid for in a

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[88] FERC, 1989, 74-77.
[89] Hogan, 1993, 175.
[90] Kahn and Baldick, 1994.
[91] Ilić and Graves, August 1995, 3.

competitive industry.[92] This is because these services have quasi-public good characteristics in that they generally benefit the system as a whole, instead of any particular individual. They are necessary for the system to work, but it is not easy to fairly appropriate their costs. If they are to be adequately provided in a competitive environment, sufficient incentives and penalties must be developed.[93]

Ilic´ *et al* [94] and Kirsch and Singh[95] suggest that these services be provided in a competitive fashion, whenever possible.[96] However, the approach of these two groups differs. Ilic´ *et al* suggest that an independent system operator be responsible for putting the services out to bid through an iterative process. On the other hand, Kirsch and Singh would have the operator assign responsibility for the services and these responsibilities could be competitively traded, much like the Clean Air Act emissions limits are traded.

Regardless of the details, it would appear that having a technically and economically efficient mechanism for the provision of ancillary services is an important detail in restructuring proposals that is often overlooked in discussions of the topic.

J.10.3 Node Pricing and Auditing

In addition to being a chief proponent of POOLCO,[97] William Hogan has developed an elaborate system of node pricing and transmission rights called the network contract model.[98] This is very comprehensive in nature and has its grounding in *Spot Pricing of Electricity*. An essential characteristic of the model is the concept of nodal pricing -- at each node on a system there is an individual production price.[99] The transmission price is the difference between the prices at the nodes connected by a transmission line. This has the obvious advantage that it equalizes marginal costs across the grid. The theory is not accepted by all, however. A fierce battle has been waged against it by researchers at the University of California-Berkeley. They present a litany of concerns with the proposal, including:[100]

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[92] At least as it is currently being forecast as a provider of a commodity - usable power. See, for example: "The Inevitable Commoditization of Electric Power Markets."
[93] Ilic´ *et al*, October 1995, 11.
[94] Ilic´ *et al*, October 1995.
[95] Kirsch and Singh, 1995.
[96] Exceptions would be distributed capacitors for reactive power support. Kirsch and Singh would also not include reactive power generation in a competitive market because of the local nature of and the monopoly power considerations that could arise.
[97] For example, see: Hogan, September 1994; and Garber, Hogan and Ruff, 1994.
[98] This is outlined in: Hogan, March 1993.
[99] At least a theoretical price, not all would agree that attempts should be made to calculate the price at *each* node.
[100] Wu *et al*, 1994; and Oren *et al*, 1995.

- Non-correlation between a transmission link's investment incentives and it associated rent;
- A single grid owner would have an incentive to degrade the network;
- Non-congested links may accrue congestion rents; and
- Firm transmission rights are incompatible with efficient dispatch.

If these concerns are overcome and such a system develops, it will be important that an audit function develops with it. This is especially true if asymmetries of information continue since only certain players would know for sure what the costs were without an audit function. Even if information becomes more open, there still should be an audit function so that the nodal prices accurately reflect the system's costs.[101] Significant changes in institutional structures may be required to effectively run such a pricing system.[102]

J.10.4 Tradable Transmission Rights

Still others suggest that the creation of secondary markets and tradable transmission rights would help create efficient price signals.[103] A tradable transmission rights system would create a secondary market for transmission capacity, in which transmission service could be bought and sold independent of transmission line owners. There are a variety of proposals at various stages of development. Secondary markets would greatly reduce, if not eliminate, a transmission utility's market power over its system. Because of the potential profound implications that this type of pricing system would have, one observed notes, "these mechanisms could supplant many of the needs for regulation [of transmission]."[104]

J.10.5 Congestion Pricing

In concept, a congestion charge is part of the opportunity cost of having one participant use a transmission line, thus denying its use and having other impacts on other users (or potential users).[105] There are several reasons for pricing congestion. First, when one puts power over a congested grid, she is preventing others from using the line and is dissipating the power of the others who are using it as well. Second, congested lines can lead to out-of-merit dispatch, where a cheaper plant(s) is prevented from producing and in its place, power must be provided by a more expensive one.[106] Third, the proceeds gained from

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[101] Kahn and Baldick, 1994, 192.
[102] Ruff, 1994.
[103] Varying discussions include: Lively, 1994; Tabors Caramanis & Associates, 1995, 29-30; Hogan, 1992; Kleindorfer, 1995; and FERC, 1989, 77-80. The FERC document discusses the potential efficiency results of these markets given different scenarios.
[104] Woychik, August-September 1995, 79.
[105] Kelly *et al*, 1987, 226.
[106] Hogan, 1992, 218.

congestion charges are an economically efficient mechanism for financing the construction of new transmission capacity when short-run marginal cost principles form the basis of pricing structures.

J.10.6 Loop Flows

A fundamental characteristic of electric power systems that is different than nearly any other system is that the delivery of electrons across the grid is not intentionally directed. "By and large, the electric grid was built purposely without "valves" to capture the huge reliability benefits that come from allowing nature -- not contracts -- to manage the flow."[107] As a result, "loop flows" occur -- when one sends power over the grid, some of it will go along the geographically "most direct" path, but some of it will go along other lines, following the path of least impedance. The result is that the same deleterious impacts that are felt along the "primary" path also occur along these parallel flow paths. However, if contracts are written only so that the utility over whose transmission system the power is theoretically wheeled -- along the legally-defined "contract [transmission] path" -- the neighboring and parallel utilities, over whose lines some or much of the power might actually flow, would not be fairly compensated. This would not only be unfair, but would result in economic and technical inefficiencies. Therefore, it is important that whatever pricing scheme is implemented take account of loop flows, either explicitly through efficient loop flow pricing, or implicitly, through a reconceptualization of pricing structure.[108]

J.10.7 More on Spot Pricing

In the past decade, the concept of variable pricing has emerged. The seminal work in this field, *Spot Pricing of Electricity*, was written by a team of MIT researchers.[109] The basic concept is that an hourly sport market for electricity would promote efficient pricing. The price in such a market would be dependent upon the supply/demand conditions at that point in time, in particular, with regard to:[110]

- Demand (in total and by location);
- Generation availability and costs (including purchases from other utilities); and
- Transmission/distribution network availability and losses.

The practical result of such a pricing system is that consumers purchase less electricity during peak (most expensive to produce and consume) periods and shift some of that demand into less expensive time periods. While time-of-use rates are considered a

107 Hogan, 1993, 19.
108 Hogan, October 1995; and Ruff, 1994.
109 Schweppe *et al*, 1987.
110 Ibid., 31.

relatively new concept, they actually have their roots in the earliest days of the industry. A 1902 Census Bureau report stated,

> From the fact that power circuits connected with central stations draw their supply of current in the daytime, when a large proportion of the generating machinery would otherwise stand idle, a great many central stations have felt they could make concessions and inducements in the way of special rates for current.[111]

J.10.8 Long-Run vs. Short-Run Marginal Cost Pricing

Let us briefly explore the debate between proponents of long-run and short-run marginal cost pricing in order to gain a better understanding of some important economic principles.

J.10.8.1 Short-Run Marginal Cost Pricing

Commodities that are bought and sold in a perfectly competitive market are theoretically priced at their short-run marginal cost.[112] In a transmission system, the primary short-run marginal costs are the transmission line losses that occur and the cost of generation adjustments due to a power flow, such as out-of-order dispatch. Also included in the short-run marginal cost is the concept of congestion (which happens when a participant's power transmission is curtailed to allow for another's to be transmitted).[113]

In addition to being the theoretical standard for pricing, short-run marginal cost pricing has several positive attributes. This pricing mechanism promotes good decision-making and equalizes short-run marginal costs across the grid.[114] Furthermore, the expected theoretical outcome of such a pricing scheme would be that both short-run and long-run operating efficiency would be encouraged.[115]

At the same time, though, there are several weaknesses to this approach. The first is that short-run marginal cost pricing will not on its own (without adulteration) lead to the construction of reserve transmission capacity, which historically has been valued in order to ensure a reliable system. Secondly, it is difficult to predict the future with sufficient accuracy because costs and demands can vary widely over time.[116] Thirdly, this congruence may not include a reasonable assumption about consumer behavior.

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[111] Census Bureau, 1902, 28.
[112] Gwartney and Stroup, 1987, 427.
[113] FERC, 1989, 87.
[114] Kelly *et al*, 1987, 167.
[115] FERC, 1989, 94. In theory, the sum of the short-run marginal costs will equal the sum of the long-run marginal costs. Put another way, the time-average of the short-run marginal cost = long-run marginal cost.
[116] FERC, 1989, 94.

> It is not clear that customers could make rational forecasts of short-run cost-based prices and arrive at expectations that correctly mimic long-run costs. Customer myopia tends to mean that current prices are given disproportionately greater weight when forecasting future prices.[117]

And finally, the presence of market power by transmission companies could provide distortions that lead to non-economic outcomes.[118]

Despite the logistical weaknesses of short-run marginal cost pricing, economists who adhere to its principles are quick to dismiss the other type of marginal cost-pricing, which explicitly includes capital charges in the price structure, long-run marginal cost pricing. Vickery comments, "To attempt to import into a pricing decision consideration of fixed costs that will not be affected even indirectly by that is to chase a very wild goose indeed."[119] Before we dismiss long-run marginal pricing, however, let us examine the principles that supportive economists are chasing.

J.10.8.2 Long-Run Marginal Cost Pricing

In the context of some situations, there are economists who advocate the use of an admittedly second-best alternative, long-run marginal cost pricing. One of these advocates is Alfred Kahn, who favors the use of long-run over short-run marginal cost pricing when one of several conditions are present.[120] The first of these is when it is too difficult, annoying, or expensive to compute the changing marginal congestion or opportunity costs. Secondly, there may be cases when short-run marginal cost pricing does not cover the average total cost over the life of a good, and therefore might require a public subsidy. Thirdly, the variability inherent in a short-run marginal price in some cases might lead to unacceptable uncertainties in attempting to make planning decisions.[121] By their nature, long-run prices will be relatively constant over time, while short-run prices will be much more volatile. Considering that electric power equipment investments (whether they be generation or load) are typically large in financial value and highly durable; there is an inherent unwillingness to make investments in such equipment under uncertain price conditions. Furthermore, this volatility cloud the transparent signals that prices are desired to send in the long-term.

In order to solve these problems, proponents of long-run marginal cost pricing attempt to explicitly include capacity charges in the pricing scheme. This pricing scheme includes the

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[117] Kelly *et al*, 1987, 183.
[118] FERC, 1989, 94.
[119] Vickery, 1985, 1333-1334.
[120] Kahn, 1970, 88.
[121] FERC, 1989, 105.

costs of expanding the capacity of the transmission network as well as incremental running costs.[122] Although long-run marginal cost pricing does not include a congestion component, it does explicitly charge for the cost of expanding capacity enough to prevent congestion. The FERC Transmission Task Force made a subtle distinction between long-run marginal cost and incremental cost, in that the latter takes the current grid as a starting point while the former bases pricing decisions on an optimally configured grid.[123] Under long-run pricing, price signals are linked to the long-run costs of the transmission system, not to its current running costs or state of congestion. As a result, the benefit of long-run marginal cost pricing is that it encourages good long-run investment decisions in terms of capital construction and energy supply alternatives.[124]

However, given the unpredictability of needs, long-term marginal cost pricing faces serious difficulties. First of all, it is nearly impossible to calculate long-term prices accurately because so little is known about the future. "The best efforts to get the long-run marginal cost properly reflected in rates will fail due to the inability to forecast long-term trends."[125] Secondly, in times of excess transmission capacity, long-run marginal cost rates will be artificially high, which will prevent some transactions from being consummated that would otherwise be economic (in a short-run cost based pricing system).[126]

J.10.8.3 Potential Resolution Of The Debate

The debate is one that could fill a thesis itself, and despite its importance, we do not spend much time attempting to resolve it. Such a resolution might appear to be difficult, based upon what has been mentioned thus far. However, if one moves away from ideological purity, a workable resolution is possible.

It can be shown that in the long-run, appropriate short-term and long-term marginal cost prices converge.[127] From this finding, one can surmise that there may not be significant differences between the two types of pricing. Having said this, though, there are limitations on this optimism. This theoretical convergence assumes that the grid is configured optimally, consumers take long-term costs into account when making current

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[122] Kelly *et al*, 1987, 172.
[123] FERC, 1989, 89-90.
[124] Kelly *et al*, 1987, ix.
[125] O'Neil and Whitmore, 1995, 73.
[126] And for which there is no compelling efficiency reason that they should not occur. Source: Kelly *et al*, 1987, ix.
[127] For a discussion of this, see Henderson *et al.*, 1987, 181-184; and FERC, 1989, 92. The inherent assumption is that the short-term marginal costs includes congestion charges that take account for scarcity.

decisions,[128] and that there is no transmission over-building.[129] All three assumptions are doubtful: the first because the system was not built using optimal economic efficiency incentives; the second because consumers tend to discount future costs;[130] and the third because there are social benefits to having a robust, over-built grid.[131]

As seen in the previous sections, it is apparent that both long-run and short-run marginal cost pricing mechanisms are imperfect.[132] As a result of these imperfections, a mixture of the two types of pricing has been proposed. Such a "mixture" of short- and long-run marginal cost pricing has been used in similar industries, such as natural gas, through the use of combined spot and forward markets. The price set in the forward market is essentially equivalent to the long-run marginal cost while the price in the spot market approximates the short-run marginal cost. If mixed pricing does not develop through the creation of actual markets, a similar result could be obtained by having short-run prices charged for interruptable service contracts and/or short-term contracts and having long-run marginal cost prices charged for long-term contracts.[133]

J.10.9 Public Goods Pricing -- System Control

Transmission consumers must also be charged efficient prices for the system control services (which will likely be unbundled from the transmission wires in a restructured industry). A frequent analogy that is used when discussing the future of the industry is the comparison of the air traffic controller in the airline system and the system operator in the deregulated electric power system.[134] When one examines the technological state of the nation's air traffic control system[135] and extends that analogy, it becomes quite clear that incentives must be developed to allow for sufficient finances so that the system control centers can continually be technologically upgraded. The latter is crucially important, because the ability of the market to function effectively is dependent upon the control center's use of state-of-the-art information technologies.[136] Much of what will be needed, in terms of information technology support, for the control of a deregulated electric power

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[128] Ibid.
[129] FERC, 1989, 92.
[130] Kelly *et al.*, 1987, 183.
[131] FERC, 1989, 92.
[132] Kelly *et al.*, 1987, 183.
[133] Kelly *et al*, 1987, ix; and FERC, 1989, 106. It should also be noted that if these contracts are transferable, it will take little time for the contract method to succumb to a formal or informal market.
[134] Stalon, October 1995; and Masiello, 1995.
[135] For example, see: "Austere Future Looms for F.A.A;" "Panel Approves Bill to Generate Funds for FAA;" and "Who Pays for Air Traffic Control, and How?"
[136] Masiello, 1995.

market is based on information technologies developed in the past several years and in some instances, technologies that must still be developed. Therefore, the use of obsolete technologies in the control center (caused by insufficient funding) could lead to the stifling of competition and the blocking of power transactions that would otherwise be economic, due to heightened transaction costs or even technological deficiency.

Not only should pricing structures provide long-term incentives for the system operator, they should provide short-term incentives as well. For example, Richard Tabors suggests that an incentive-based regulatory scheme should be developed to give the ISO efficiency incentives in the short-term.[137] This would provide the system operators with incentives to lower the total grid cost, and in all likelihood would lead to the elimination of some reserve margins and replace them with the creativity of the ISO.

[137] Tabors, 13 November 1995.

Appendix K
Speculations on the Development of Complete NUTS

There is no guarantee that the particular economic outcome selected from among the many alternatives will be the "best" one. Furthermore, once tandem economic events select a particular path, the choice may become locked-in regardless of the advantages of the alternatives. If one product or nation in a competitive marketplace gets ahead by "chance," it tends to stay ahead and even increase its lead.[1]

-- W. Brian Arthur (1990)

K.1 INTRODUCTION

In Chapter 11 we discuss the prospects for the development of non-utility transmission systems (NUTS). In Section 11.7 we discuss, in vague terms, possible pathways -- industry events that individually or cumulatively could lead the industry down an incremental path -- to complete NUTS development. We do not expand on some of these pathways in Chapter 11, as doing so would be a highly speculative endeavor, that is bound to be incorrect in many cases. However, in this appendix we engage in more speculative behavior -- by giving more details on how those pathways *might* develop. In doing so, we are not suggesting that these pathways will actually occur, but rather, the discussion is intended to be mind stretching and opening.

K.2 SECONDARY MARKETS

Secondary transmission markets and/or congestion contract rights[2] are one potential pathway for NUTS development. William Hogan developed the most elegant secondary markets formulation, the contract network model for transmission rights.[3] This system explicitly provides revenues to build transmission lines -- whether they be built by transmission utilities or "outside" investors (Nutcos).[4] In a similar vein, Mark Lively proposes that a real-time pricing scheme could allow a financier to offer a transmission futures contract. In such a case, "when the expected RTP [real time price] difference

[1]Arthur, 1990, 92.
[2]Which could take different forms and have varying degrees of efficiency.
[3]See Hogan, 1992; and Hogan, March, 1993.
[4]Hogan, March 1993, 27-28; and Hogan, 19 October 1995.

[between two points on the grid] grows too large, the financier would invest in a transmission line connecting the two geographic points."[5] Eric Woychik divines what could result when ownership and operation of transmission assets are separated and secondary markets are created.

> If tradable transmission rights and congestion pricing can be market-based, and third parties are allowed to invest, these mechanisms can supplant many of the needs for regulation... Private entities in competition can then develop and can offer other services.[6]

Tabors *et al*[7] envision an even more competitive transmission market -- where firm and non-firm transmission service contracts would be consummated and an active spot market for interruptable transmission service would develop. Transmission companies, aggregators, and generation companies would buy and sell in the interruptable spot market. In all of these scenarios, the finances and operation of the system would become unbundled, new constituencies would emerge, and sources of transmission service revenue would be created that could be captured by Nutcos.

The mere existence of secondary markets would not inherently lead to the efficient creation of partial NUTS, however. For example, Bushnell and Stoft mathematically "prove" that the rules used to develop and allocate transmission rights-based contracts would play an important role in their ability to efficiently expand the grid.[8] Inefficient expansion mechanisms could serve as a significant impediment to investment in them. Conversely, inefficient allocation rules might lead to the creation of NUTS, since incentives to circumvent inefficient structures are sometimes more effective at creating partial NUTS than the incentives created by an efficient structure.[9]

These speculations and visions may soon come into being. The Mega-NOPR calls for the development of secondary markets for firm transmission service, and the California Final proposal also calls for an undefined system of transmission rights and congestion contracts.

K.3 UTILITIES ACTIVELY TURN TO NUTS FOR ADDITIONAL CAPACITY

In the generation segment of the industry, the emergence of IPPs was partially the result of an "almost total abdication by the industry of its traditional role as builders of new

[5]Lively, 1994, 31.
[6]Woychik, August-September 1995, 79.
[7]Tabors, Caramanis and Associates, 1995.
[8]Bushnell and Stoft, 1996, 74.
[9]See Section 11.7.8.

capacity"[10] during the period of rate suppression. There are several circumstances that could lead to similar behavior by transmission utilities (i.e. cessation of building new assets or even the sale of existing ones), which would allow a segue for partial Nutcos.

K.3.1 <u>To Reduce Exposure</u>

Just as the regulatory risks and difficulties of building generating plants (e.g. prudence reviews) helped lead some utilities out of the generation business in the 1980s, problems with transmission siting, financing, permitting, and construction, as well as EMF lawsuits could make utilities less enthusiastic about being in the transmission business.[11] In the extreme case, utilities could turn to outsiders to build and/or own new transmission lines in an attempt to absolve themselves of legal difficulties or minimize their financial exposure. However, because of their "boomerang" experience with generation -- outsourcing it, and in the process, laying the foundation for industry competition -- utilities would likely be reluctant to employ this strategy.

K.3.2 <u>Utilities Sharpen Focus, to the Exclusion of Transmission</u>

Another reason that some utilities might willingly turn to outsiders for transmission service provision is that as they reposition themselves for competition, they may no longer view transmission as part of their "mission."[12] These utilities could sell-off parts of their transmission operations or they could make an internal decision not to build any new capacity, which would create an opening for Nutcos when additional capacity is needed.

K.3.3 <u>Industry Structure Uncertainty</u>

Elsewhere we mention that the amount of transmission capacity being built has dropped precipitously over the past several years as a result of the uncertainty that exists regarding transmission capital recovery during this transition period. If this period of uncertainty, and resulting underbuilding, would continue over an extended period of time, utilities might turn to less risk-averse investors (Nutcos) to build additional, necessary capacity. Likewise, if the FERC ends this period of transition uncertainty with an "unfavorable" transmission service recovery decision, and new transmission capacity is subsequently necessary, a utility could turn to Nutcos that are willing to gamble that the FERC would eventually raise the allowed recovery rates.

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[10]Navarro, 1995, 350.

[11]Roseman, 1991, 36.

[12]It is doubtful that many utilities would forsake the relatively comfortable world of regulated transmission, but a few might -- perhaps those that are in the upper echelon of generation efficiency.

K.3.4 Utility Financial Weakness

Some utilities that are poorly positioned for competition could need to add transmission capacity in order to accommodate outside suppliers that wheel power into their service territories. Because these utilities would be in poor financial shape and losing customers, they may lack sufficient financial credibility to attract the capital necessary[13] to construct new lines. They could turn to more financially credible Nutcos to construct the new lines.

K.3.5 Utilities Add Transmission Capacity by Auctions

It is conceivable that auctions to build new transmission capacity could develop.[14] These auctions would most likely occur if transmission capacity expansion would be planned by an ISO or signaled by congestion contracts, rather than by the incumbent, vertically-integrated utility. However, transmission auctions could occur even without these "radical" moves. In the generation segment of the industry, many utilities hold auctions for new capacity even though they still operate in the context and regulatory policies of the traditional integrated utility industry structure. These auctions have emerged by the voluntary choice of utilities in some cases, and by the directives of regulators in others.[15] Whether the result of congestion contracts, ISO planning, or utility or regulatory decision, Roseman posits how these auctions could function.

> One can conceive of utilities holding a solicitation for the construction and ownership of a needed new power line between specific points. In such a solicitation, the utility could conceivably arrange for the right-of-way and obtain the regulatory approval. The wining bidder(s) would be required to finance, construct, and operate the line in a manner consistent with the utilities' standards for long-term reliability, in exchange for payment for every kilowatt-hour that flowed on the line.[16]

K.3.6 Auctions as Mechanisms for Stimulating New Technologies

One way of stimulating the use of new transmission technologies would be to take an analogous approach to what has been done with QFs and integrated resource planning. Assuming that regulation is retained, public utility commissions could insert provisions into the rules of transmission construction auctions that would favor bids that would employ new technologies.

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[13] Or at least at a reasonable rate.

[14] Such auctions already exist in Argentina. Source: Lalor and Garcia, 1996, 71, note 15.

[15] For a history of this see: Joskow, 1989, 175-187. In 1994, 18 states required these auctions. Source: The Southern Company, 1994, 13.

[16] Roseman, 1991, 36.

New transmission line capacity is not the only type of transmission service provision for which there could be supply auctions. Proposals being developed for the provision of ancillary services by auction. Once again, regulatory bodies could attempt to stimulate technological development by tweaking the auction rules to favor new technologies. While attempts to stimulate new technologies through these methods may not be economically efficient in the short-term, they may lead to long-term efficiency increases.[17]

K.4 FISSURE BETWEEN OWNERSHIP AND OPERATION

Explicitly clear in the California POOLCO, Bilateral and Final proposals is the division between transmission system dispatch and control (which would be performed by the ISO) and ownership (utilities would continue to own their current assets). Less clear is whether further separations should occur. For example, some analysts argue that transmission ownership and maintenance functions be separated;[18] the ISO would lease *and* maintain transmission lines and associated equipment from utilities. The result is a profound shift in the nature of transmission ownership. In the past, the prerequisites for transmission system ownership were (1) the ability to operate and maintain a transmission system and (2) the ability to attract the capital necessary to finance its construction. The creation of an ISO for system dispatch and control significantly weakens the former, and, it is eliminated when the ISO also has the responsibility for system maintenance. The result of this unbundling of technical and financial prerequisites is that there is no reason that any company or group of investors could not own transmission lines. Thus, transmission line partial Nutcos would be viable.

K.5 CONTINUED INDUSTRY UNBUNDLING

The current industry restructuring features an unbundling of generation, which was once a natural monopoly, from those functions that are still natural monopolies -- transmission and distribution. In some conceptions of the industry, the latter would also be unbundled into electricity sales (not a natural monopoly) and the monopoly wires aspect of distribution.[19] The experience in other industries has been that unbundling is a progressive phenomenon -- functions once considered inseparable become unbundled over time.[20] Given current

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[17]Note the emphasis on "may." PURPA has caused some successes and some dismal failures. As mentioned in Appendix B.8, significant stranded liability bills have been amassed as the result of pushing PURPA technologies.
[18]Tabors, 13 November 1995.
[19]For example, see: Wisconsin Public Service Commission, October 1995, 9; and Tabors Caramanis & Associates, 1995.
[20]Gottlieb and Colucci, 1995.

technologies, some transmission system functions, such as system control, will likely retain natural monopoly characteristics. However, there are some transmission system functions that do not appear have natural monopoly characteristics and therefore could be unbundled from those that do.

K.5.1 Ancillary Services

Some of the ancillary services are probably unbundleable. In the policy arena, the FERC took the lead in calling for their unbundling and provision through competitive mechanisms. In the technical community, several frameworks have been developed that would allow for competitive bidding for ancillary service provision to ISOs.[21] The feasibility of going a step further (which has been advocated in the policy community) -- having ancillary services provided not only competitively to the system operator, but also in competition with the ISO -- is still an open question, as is the feasibility of having specific ones being provided competitively. This uncertainty, stemming from both technical and economic considerations, is the result of ancillary services always having been provided as part of an integrated, bundled package. From an economic standpoint, the public goods nature of ancillary services makes their costs difficult to appropriate. From a technical standpoint, the highly complicated, integrated nature of transmission systems makes ancillary service functions difficult to separate. Due to the technical nature of some ancillary services, they could be localized natural monopolies. For all of these reasons, it is difficult to determine the extent to which each ancillary service could be unbundled, especially prior to experience in a competitive industry environment.[22]

Regardless of how far the competitive provision of ancillary services is taken immediately, several hypotheses can be made. The first is that any unbundling of ancillary services is a significant step in that it would create the potential for partial Nutcos to enter the industry. Secondly, even if ancillary services competition is initially limited to provision to the system operator of only a few of the services, experience gained in the unbundled framework and increased technical sophistication would stimulate further competition -- both in terms of the number of services made competitive and the opportunity to compete against the ISO for provision to customers.

While ancillary service provision is a minor part of the electric power industry; at $5-10 billion per year it could represent an attractive niche for some parties (ancillary services

[21] Ilic´ *et al.* October 1995; Zobian, 1996.
[22] Zobian, 1996.

partial Nutcos). For example, utilities with strong operating competencies could build or purchase plants that are particularly well-positioned to provide ancillary services. Perhaps even some that strategically retreat from the MW production market could thrive in the ancillary services provision industry.

K.5.2 Transmission Construction and Ownership

While the lines in any given transmission corridor appear to have natural monopoly characteristics; the ownership of the various lines in a transmission system does not appear to be a natural monopoly.[23] Any ownership scale economies that might exist would be diminished if an ISO were to operate and control a transmission system, and would be eliminated if the ISO were to also maintain the system. This is evidenced by the success of tight power pools such as the New England Power Pool (NEPOOL), which function effectively with a system operator and multiple transmission asset owners.[24] This implies that transmission ownership could be unbundled -- which could be manifested in market-based processes for the construction and ownership of new transmission capacity.

K.5.3 ISO Construction of Transmission Facilities

Another closely related option is that the ISO could have responsibility for constructing new transmission facilities. The California Final proposal gives some thought to having the ISO collect congestion revenues for the purpose of the ISO (rather than utilities) building future transmission lines.[25] If this were to occur, an ISO could put out bids for transmission capacity construction and/or maintenance (by independent or utility-affiliated partial Nutcos) rather than enter into the transmission business itself.

K.5.4 Why Unbundling Matters

These three types of unbundlings could lead to a "hollowing out" of grid functions, where the transmission "provider" changes from being an integrated transmission utility to a collection of companies providing services that are coordinated by a system operator. We postulate that a transmission system that includes multiple Nutcos would more readily allow for the emergence of competing complete NUTS than would a transmission system that is operated by a vertically-integrated transmission utility with a franchised service territory. We postulate this for several reasons. First, the multiple Nutco situation would

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[23]Put more tangibly, a transmission line from Boston to Hartford might be a natural monopoly, but owning multiple lines: Boston/Hartford, Boston/Worchester, and Providence/Hartford likely does not have natural monopoly characteristics.

[24]For a discussion of several multi-owner systems, see: Tabors, Caramanis and Associates, 1995, 33.

[25]CPUC, D.95-12-063, 95.

build technical competencies in multiple players. Second, it would create new political constituencies (partial Nutcos) who could then clamor for a "bigger piece of the action" should new technology make it feasible. Third, a situation where multiple players would be seeking competitive advantage would likely encourage technological development, which could drive further change.

Biographical Note

Do something useful, then forget about it and go on to the next thing. Don't gloat about it.[1]

-- *David Packard (1993)*

Joseph Jerome (Joe) Bambenek was born on 6 April 1970 to Jerome Vincent and Mary Ann (Papenfuss) Bambenek in Minneapolis, MN.[2] Several days later he was taken to the Bambenek home at 1306 West 21st Street in Hastings, MN, which he calls "home" to this day. On 13 January 1973, he was joined by sister Catherine Marie (who is currently a graduate student in the Department of Materials Science and Engineering). He attended kindergarten at Pinecrest Elementary school in Hastings and went to Hastings Parochial School from 1st through 8th grade. In 9th grade Joe was a student at the nationally recognized Hastings Junior High School and attended 10th-12th grade at Hastings Senior High School. He was baptized into St. Boniface Catholic Church on 19 April 1970, of which he remained a member until 1987, when the church was merged with Guardian Angels to form St. Elizabeth Ann Seton Church (of which he is now a member).

As a student at Hastings High School, Joe played in the band (clarinet, alto clarinet and bass clarinet), participated in Math Team, Science Olympiad and Knowledge Bowl, played on the football team, ran on the track team, was the scorekeeper for the basketball team, and graduated as a valedictorian on 10 June 1988.

Joe attended Northeast Missouri State University (NMSU) in Kirksville, MO, from where he graduate *magna cum laude* with a Bachelor of Science in Physics and minor in chemistry on 8 May 1993. He served on numerous university committees and participated in a variety of organizations, including Society of Physics Students, OSCAR (the environmental club), Student Ambassadors, and Student Senate -- of which he was the President during the 1992-1993 academic year.

As a graduate student at MIT, Joe was an active member of the MIT Graduate Student Council and the Tech Catholic Community. From January 1994 until the present, he worked as a research assistant for Professor Richard K. Lester. The focus of Joe's work was assisting Professor Lester with his forthcoming book, *Regaining the Productive Edge*. For his efforts in the MIT Community, Joe was awarded the 1994 Alumni Award for Leadership and Excellence in Technology and Policy (awarded in May 1995), and the Institute's 1995 Karl Taylor Compton Award.

<u>Publications</u>:

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[1] Cited in: "Silicon Valley's Class Act;" and "David Packard, 83, Pioneer of Silicon Valley, Is Dead."

[2] Who are the children of Vincent Albert (1901-1983) and Sophie Cecelia Stanislawski (1907-1990) Bambenek; and Victor William (1905-1992) and Margaret Elizabeth Hennessey (1905-) Papenfuss.

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The forecast is always wrong.[1] -- *Richard de Neufville (1990)*

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[1] de Neufville, 1990, 273.

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